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Reprinted from "Heart."
Vol. II, No. 4, August, 1911.

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RALPH STOCKMAN.

DIGITALIS.

By JAMES MACKENZIE.

(*From the Cardiac Wards, Mount Vernon Hospital, London*).

Introduction.

Some preparation of the fox glove plant (*digitalis purpurea*) has had a place in domestic and medical therapy for centuries. It was however a Birmingham physician, Withering,[18] who in 1785 published his "Account of the Foxglove" and recorded the first reliable observations on its medicinal properties. Although he was most impressed with its diuretic properties, and it was to demonstrate this effect that he published his book, yet he also observed and commented upon cases of heart failure, in which digitalis had had a good effect. From the time of Withering's publication we find in the writings of clinicians repeated references to the action of digitalis on the heart. The most striking effect noticed has been the slowing of the heart's rate, and from this observation, digitalis has come to be regarded as a cardiac sedative, ("Ce grand moderateur, cette sorte d'opium de coeur" s Bouilland[4] describes it), though Alan Burns[6] had observed its good ffects in dilatation of the heart. Its effect in improving the general condition of the patient, and its action on the digestive system were also widely recognised. But until the middle of the last century, the main action of the digitalis, beyond the diuretic effect, was its action in slowing the heart's rate, and so impressed were the profession with this effect, then as they are to-day, that it was used in all sorts of cases where there was an excited or rapid action of the heart. We can now demonstrate that it is chiefly in one class of case that this action is so distinctive, but as this was not formerly recognised, the drug was used indiscriminately, and as it was found ineffective n many cases, digitalis came to be regarded by some as very capricious in its action, while others have attributed the frequent absence of result to the inefficacy of the preparation used.

The view that digitalis is a cardiac sedative led to a restriction of its use. Thus Corrigan[7] reasoning that because it increased the duration of the diastolic period of the cardiac cycle, assumed it would be a dangerous drug in aortic regurgitation, a view still held by many clinicians.

In the middle of the last century, with the advent of experimental observation on the action of drugs, clinicians began to seek in their patients, results corresponding to those found by the physiologist and experimental pharmacologist. It is from this standpoint that the more recent clinical writers have attempted to describe the action of digitalis, and to a certain extent, these preconceived ideas have influenced their suggestions as to its use and action. Partly on account of the theoretical effects expected from the use of digitalis, and partly on account of the seeming variability in its action, the present day views on the action of digitalis are extremely confusing. Many physicians advocate some special preparation, and there is no agreement as to the most serviceable form in which it may be given. In like manner, the dose and its manner of acting is unsettled. Some maintain that with small doses they get a reaction, while others are equally confident that it is only by larger doses that the effects are produced. Some calculate to find evidence of its effect in a few minutes after its administration; while others maintain that it can act only when the system has received a sufficient quantity, and that it may be several days before even moderate and regular doses can be shown to have any result.

It is now almost invariably held that digitalis causes constriction of the blood vessels, and as such constriction tends to raise the blood pressure, the drug is supposed to be contra-indicated in cases of high blood pressure. This view seems to be based more on theoretical considerations, derived from the results of pharmacological experiments, than on careful observation on the human subject.

It will be realised that there is some need for an investigation into the action of digitalis on the human heart. Till recent years such a thing was not practicable, inasmuch as many of the phenomena produced by digitalis were so obscure in their nature, that when they appeared, their interpretation was not possible. With the recent advances that have been made in the interpretation of the meaning of obscure phenomena, we are now better prepared to observe and record those changes in the circulatory system, which are due to the action of remedies in the ordinary routine of therapeutic practice. We may not be able to solve all the phenomena which are detected but we know sufficient to help us to advance the study of the subject to some extent.

Many years ago I was struck with the variability in the action of digitalis in different patients, and a careful grouping of cases which presented similar effects led me to realise that, to a great extent, the different reactions obtained in different people are due to a difference, not in the drug, but in the nature of the lesion from which the patients suffer. I drew attention to this fact in a paper published in 1904,[13] and gave more extended observations in a book on diseases of the heart, published in 1908.[12] These observations were made in the course of my routine work in general practice, and lacked the precision and definiteness which can be obtained in hospital practice. When I was appointed to the charge of the cardiac

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wards at the Mount Vernon Hospital, I seized the opportunity to study the effects of cardiac remedies in more detail. My previous experience gave me very clear and definite lines to follow, and while engaged in following them, other problems arose, which we attempted to settle; but many of them were beyond our powers, requiring new methods of observation, which we had not the means of employing. The following account of observations is therefore only partial, and though it reveals many new points, and explains much that has hitherto been obscure, it is to be considered merely as the beginning of a series of observations, which need to be carried on by many workers, on a large number of patients and by improved methods. The conclusions drawn from the observations here recorded must be considered as tentative. In order that the reader may recognise the nature of the complaints from which patients suffered who have or have not reacted to digitalis, I have added a sufficiently detailed account of each patient to permit of its recognition.

Methods.

In a previous number of this Journal,[11] I gave an account of the methods we employed in the work. These consisted in the close observation of the patient from day to day, noting the character of every symptom, and how it became modified under the influence of treatment. An attempt was made to recognise all the agencies that might possibly modify the effects of the drug. The process of observation was slow and tedious, and the results were only to be obtained by the most painstaking observation of the minutest details. Such simple matters as the recording of pulse and blood pressure needed the most careful attention, as outside circumstances influenced them readily. Certain phenomena, such as irregularities, might occur at rare intervals, and these, to be detected and fully appreciated, needed to be graphically recorded. Graphic records had often to be taken for long periods, sometimes extending to one to two hours, and with great care in order that the nature of the irregularity could be clearly recognised. Certain of the effects of digitalis could only be recognised by observing the response of the heart to effort,—for certain peculiar effects only arose during effort, or when the heart's rate was slowing after effort. As comparatively few of these effects are recorded here, they convey little idea of the amount of work that has been spent in acquiring a knowledge of them, and of the great amount of negative observation which was necessitated.

We have been greatly assisted in our observations by the help and suggestions of Professor Cushny, who associated himself with us in making the observations, assisted us in the interpretations of our results and experimentally tested the relative efficacy of the drugs we used.

The final results could never have been arrived at without the enthusiastic collaboration of my colleagues, Dr. Hume Turnbull, Dr. F. W. Price, Dr. Silberberg and others.

In cases of obscurity and where more precise information was wanted, Dr. Lewis made electrocardiographic observations and interpreted the results for us.

Preparation of the drug and doses employed.

Preparation used. We thought it advisable to limit our observation in the first instance chiefly to one preparation in order to obtain clear and comparable results. In order that our observations might be of practical value to medical men generally, we used the form which is probably the one most frequently prescribed, namely, the B. P. tincture of digitalis. In my earlier observations I had chiefly used the tincture and had always found it efficient ; my experience of its service for many years in private practice has been corroborated by the experiences detailed in this article. We tried to estimate the relative value of other preparations ; thus, we found that 15 minims of the tincture of digitalis were equal to one granule of Nativelle's digitalin, (which contains $\frac{1}{4}$ milligramme of crystallized digitaline). This conclusion was arrived at by watching for the first sign of a reaction produced by the digitalis, and noting the quantity of the drug which had been taken. From my past experience, I had similarly estimated the relative strength of the well-known pill (containing Pulv. digitalis, Pulv. scillae and Pil. hydrarg, of each one grain) and found that one pill of this combination was approximately equal to 15 minims of the tincture of digitalis. In this instance the constituent squills must be taken into consideration.

Doses used to produce a reaction.

The efficiency of the drug was estimated by prescribing the tincture in a given case in doses of 15 minims or 20 minims, three or four times a day, usually giving the patient one drachm per day and continuing the drug until some definite reaction was obtained. The effects on the kidney, stomach and heart were particularly observed, as it is from one of those organs that the first symptoms usually appear. From the records of cases given, it will be seen that in auricular fibrillation, the slowing of the heart was often distinct before the appearance of any stomach symptom. With the continuance of the drug, nausea appeared, and this was usually the first symptom produced in cases with the normal rhythm. The effect on the rate of the heart was usually slight in cases with the normal rhythm, but the stomach symptoms appeared in cases of auricular fibrillation and normal rhythm with the same or approximately the same total dose. The average quantity which produced nausea in most cases was from five to eight drachms, when taken in doses of about one drachm per day. In the few cases where doses of two drachms were given per day, the reaction appeared after a smaller quantity was given.

Doses used to maintain a beneficial effect.

In many cases presenting auricular fibrillation the heart reverted to the condition it was in before the drug was given when the effects of the drug passed off. It was therefore deemed advisable to maintain the effects of the digitalis in these cases, and many observations were made to find out the quantity by means of which this object could be attained. Here the data are too scant to allow of broad conclusions. In *CASE 2*, it took 45 minims per day ; in *CASE 1*, one drachm per week ; in *CASE 12*, one granule of digitalin per day ; in *CASES 3*, *5* and *7*, it took 30 to 40 minims daily. These were all cases of auricular fibrillation. In the cases with the normal rhythm, the improvement was usually maintained without continuing the drug, unless the patient exhausted his *work force*. This agreed with my experience in private cases ; little good was obtained by keeping patients exhibiting the normal rhythm on digitalis, unless sufficient rest was taken. This in a measure also applied to the cases with auricular fibrillation, but in these, the effects of the digitalis were so striking, as in *CASE 1*, as to emphasise the fact that there are factors present in auricular fibrillation which are not present in patients with the normal rhythm.

The method of estimating the necessary quantity was largely left to the patient, with instructions as to the symptoms of a sufficiency, and such patients are generally competent to tell the quantity which acts best ; their own sensations are usually the most efficient guide. I have observed the good effects of digitalis taken continuously in small doses when it is required for long periods. One man with auricular fibrillation whom I have had under observation for over ten years made an infusion of digitalis for himself. His guide for its use was the extent of the swelling of his legs. If he could not lace his boots comfortably, he knew it was time to take his digitalis, and in a few days the swelling was diminished and he stopped the drug. *CASE 1* takes an occasional dose when he feels his heart flutter.

Dangerous doses. It is frequently stated in text books that great care should be taken in the administration of digitalis, because of its tendency to produce fatal syncope. Some go so far as to state that a patient taking fair doses of digitalis should be kept in bed, and not even be allowed to get up to micturate. Unfortunately no record of these dangerous cases is given, and seeing that a very large percentage of all patients with heart affections are given digitalis at one time or another, it is not surprising that patients who have been taking digitalis should occasionally die suddenly. As a matter of observation extending over a long period of years, during which my attention has been especially directed to the action of this drug, I have never seen the slightest danger arise from the taking of digitalis in the doses given here. If the drug is stopped as soon as vomiting or nausea appears, or when the heart's rate falls under 50, I am confident no untoward result will arise.

GENERAL EFFECTS OF DIGITALIS.

The clinician in adopting the ideas and language of the experimental pharmacologist has been misled into a fancied interpretation of the action of this drug, which has little foundation on observed fact. The experimental pharmacologist by his precise methods has done a great deal in revealing the action of digitalis, but the clinician must exercise great judgment in the application of this knowledge in the treatment of his patient, and must himself conduct observations of equal precision.

The striking feature which has appeared as a result of our researches is the dependence of the reaction to the drug upon the nature of the lesion from which the patient suffers. This is a feature which is beyond the ken of the experimentalist, for the hearts he works with are normal hearts, and the reactions of diseased hearts are incapable of experimental reproduction. Moreover, there is another great difference between the experimental and clinical results, in that the experimentalist usually obtains his results in a few hours, and in order to do so has to use doses of a size out of all proportion to that which the clinician, who may not get his results till after several days, can employ.

From these considerations, we have thought it best to make as careful a collection of facts as possible, untramelled by any preconceived ideas of how digitalis acts, except in so far that some hypothesis might suggest definite lines to follow in the research. This detailed recording of individual cases is all the more necessary, because hitherto the great bulk of clinical observation has been reported in the form of vague generalisations, or as isolated facts, apart from the circumstances which may have given these facts their peculiar character.

The generalisations which follow are not intended as final, but are merely provisional suggestions.

I have been able to separate from the numerous patients to whom I have given digitalis, one group in particular, where the reaction in the heart is so striking, as to enable us to recognise the kind of heart in which a beneficial reaction may be expected. It has been known for a long while that digitalis acts upon certain hearts very speedily, causing great slowing in their rate, and at the same time remarkable improvement in the patient's condition. The class of patient in whom this occurs is limited almost entirely to patients with auricular fibrillation. Occasionally we encounter patients with a normal rhythm, where there is a remarkable slowing of the rate, as in (*CASES 24* and *52*), but these are, in my experience, rare.

As the result of these observations, so far as slowing of the heart's rate is concerned, it may be laid down as a law, that the reaction to digitalis is far less effective when the rhythm is normal than where there is auricular fibrillation. Moreover, when the heart is affected by agents which increase its excitability, the digitalis has little effect upon the rate, whether there is auricular fibrillation or whether the rhythm is normal. This happens for instance in cases with a rise of temperature, when the heart rate is apparently increased only by the temperature and not by the invasion of the heart by a specific organism. Bearing on this point I give brief records of three cases from a series of phthisical patients with a moderate temperature, in which Dr. Evans tried to slow the pulse rate, but though the digitalis was pushed till sickness arose, no slowing of the rate took place. This failure of effect is also evident in conditions where the heart is affected by poisons, whether simple or microbic, as for instance, alcohol, the poisons of infective disease, the specific agent in acute and subacute rheumatism, and the various infective affections of the heart (see *CASE 13*), a modification in the susceptibility to digitalis is also produced by certain changes in the cardiac muscle. At all events, experience shows that reaction to digitalis in auricular fibrillation is much more readily induced in cases with presumably a good deal of healthy heart muscle, than in cases with extensive degeneration of the heart muscle. We find the most striking reaction in the heart of the young, but in the senile heart with auricular fibrillation, we frequently fail to find any reaction, particularly in those without a rheumatic history, and where extensive fibrous degeneration of the heart muscle is found at the post-mortem examination.

Another characteristic reaction is sometimes found in patients with the normal rhythm when the ventricular rhythm becomes irregular, as a result of the stimulus from the auricle failing at times to reach the ventricle (partial heart-block). This reaction I had previously found in a number of cases where there was a delay in the passage of the stimulus from auricle to ventricle, and I was able to anticipate the occurrence of higher grades of heart-block from this circumstance. In one case, which came to autopsy, and where during life there had been a delay in transmission of the stimulus from auricle to ventricle, and where digitalis produced partial heart-block, the *A-V* bundle was found to be damaged. In carefully scrutinising the cases given here where heart-block occurred, (*CASES 17*, *18*, *21*, *24*, *27*), there was no evidence of a delay between auricular and ventricular contractions before the digitalis was given.

The action of digitalis as a diuretic is not very evident in the majority of cases given here. Probably this was due to the fact that so few of the patients had dropsy as a symptom. When this was present, it soon disappeared, with the increased flow of urine.

Tolerance to the drug was on the whole very fairly constant. In exceptional cases moderate doses were taken for long periods with no apparent effect, but on the whole the quantity, which when given produced a reaction, was constant. Nausea was nearly always amongst the first symptoms, and if the drug was pushed, vomiting occurred, accompanied by a feeling of malaise, and often by headache, which was sometimes very distressing. When the drug was stopped, all disagreeable sensations passed off in one or two days, and the patient felt very well.

The improvement in the patient's condition due to the digitalis was most evident in cases of auricular fibrillation. Many of these cases were extremely ill upon admission, and all speedily improved once the digitalis began to act. In cases with the normal rhythm the improvement was not very marked as a rule, and in most of them it is doubtful whether the rest alone was not sufficient to account for the slight improvement.

The maintenance of the improvement is one of the most difficult matters to understand. The improvement in most cases of auricular fibrillation lasted only a few days after the cessation of the drug, and an attempt was made to give the patient just enough of the drug as would maintain the good effect without producing the disagreeable symptoms, and in several cases, (*1*, *2*, *5*, *7*, *11*, *12*), this was very successfully accomplished. With the normal rhythm, this tendency to relapse after cessation of the drug was not seen. That improvement under such circumstances is not due solely to slowing of the heart's action can be inferred from a case of heart-block (*CASE 39*), where there was no effect on the pulse rate, but where the improvement was most marked.

Improvement in the patient's condition.

The degrees of heart failure were so varied that it is difficult to represent in any reliable manner the effects of digitalis in restoring the patient's strength. We have attempted to do this in the records of the cases by giving the patient's sensations and noting any evident sign. The terms used to indicate the improvement are not sufficient to express clearly the degree of improvement. They are therefore used with this reservation, that they represent the patient's feelings in comparison with a preceding state, and do not admit of comparison with the feelings of another patient.

To appreciate better the improvement, I will recapitulate briefly the standard I described in the paper dealing with our methods.[11] The heart force is looked upon as consisting of a rest force and of a work force. The rest force is that which enables the heart to carry on an efficient circulation when the body is at rest. The work force is that which enables the heart to meet the calls of the body when engaged in effort. Heart failure means, in the first instance an exhaustion of the work force, which may vary in degree, but is shown by a premature exhaustion of the muscle in response to effort. Heart failure is recognised by the patient suffering distress in the performance of some effort he was wont to undertake without distress. When exhaustion of the work force is complete, there is an encroachment on the rest force, and this impairment of the rest force is manifested by such signs as prostration, general discomfort, or inability to lie flat without distress, or dropsy.

When the patient's state improves, we have to consider the extent of the exhaustion, and the extent to which improvement is possible with a heart affected by lesions which mar its efficiency; and it is at once evident that it is hopeless to expect a recovery of the strength exhibited by a healthy heart. It follows that only a limited amount of force can be regained by the heart, in some cases so limited an amount that there is little or none to spare for work, and hence the patient's heart is able to maintain an efficient circulation only so long as the body is under most favourable conditions. The description of the patients' sensations, given in the record of cases, refers therefore only to his feelings when at rest or after a very limited amount of effort. The amount of restoration of the work force varies greatly, but I have not found a standard of sufficient accuracy with which it may be compared.

In most cases of auricular fibrillation, the condition on admission was such that the rest force was manifestly exhausted, for when in bed, the breathing was laboured, and the patients had to be propped up. In nearly all those instances, where a sufficiency of the drug was taken, the effects of digitalis were extremely good. All the patients were able to lie flat, and were freed from distress of breathing and the sense of discomfort. Some never improved beyond this stage, the effort of standing and walking at once exhausting the heart's strength. In others the improvement, though slow, was steady and ultimately such an amount of work force was acquired, that strenuous work was afterwards undertaken.

One patient (*CASE 1*) was able to keep at his work by judicious continuance of small doses of digitalis. *CASE 7* improved much more slowly, being eleven months under treatment, but when discharged he had acquired a sufficient amount of work force as to enable him to undertake light employment. *CASE 6* recovered so far as to be able to resume his work as a waiter.

In most cases exhibiting the normal rhythm the heart failure was not so extreme, and the improvement was not so marked, the rest force not being exhausted, or only very slightly so, after a few days' rest the patients were free from pain and discomfort, the only sign of exhaustion being produced by efforts such as walking upstairs. Moreover it is doubtful how far the digitalis helped to restore them to the limited recovery which they attained. Before admission they had been exhausting their work force day by day and they only needed a period of rest to permit of a reserve being stored.

In such patients as *CASE 27*, the digitalis undoubtedly had a good effect, even though there were few objective signs of improvement. When under the influence of digitalis to such an extent that he had partial heart-block, this patient felt remarkably well and was able to go about and up a flight of stairs without distress. It is to be noted that this improvement was not coincident with the actual slowing of the auricular rate, although on account of the heart-block, the ventricular rate was slow and irregular.

Though death suddenly occurred in *CASE 28*, he temporarily experienced great improvement, with no change in the heart's rate.

Effect on the digestive tract.

In practically all the cases of normal rhythm, the first symptom was loss of appetite accompanied by nausea. If the drug was continued, vomiting was induced as a rule. This also happened in cases of auricular fibrillation, but a slowing of the heart generally preceded the stomach symptoms ; in two cases (*14* and *15*) the slowing occurred on the same day as the vomiting. Accompanying the nausea, there was a feeling of malaise, the patient feeling extremely unwell. A headache was frequently present, and was sometimes very severe. In no case did the digitalis cause diarrhœa, although in my former experiences, diarrhœa was occasionally provoked. With the other drugs of this group, strophanthus and squills, diarrhœa was more readily provoked. The same symptom has also been noted as a result of helleborein administration.

With the cessation of the drugging the stomach symptoms speedily passed away. In no case was there persistent vomiting, as is sometimes described. With the disappearance of the stomach symptoms, the patient quickly recovered his sense of well-being, sometimes feeling particularly bright and well a day or two after the drug had been stopped. As a rule, there was little difficulty in avoiding the disagreeable stomach sensations, when in cases of auricular fibrillation the circulatory effects could be maintained by the influence of smaller doses.

Effect on the nervous system.

The most frequent nervous symptom was headache. Sometimes it was very severe, and in *CASE 7* it prevented the continuance of the drug for a long time, though it was having a good effect upon the heart. The association of headache, nausea, and the feeling of malaise was fairly frequent, (*CASES 1, 2, 3, 7, 8, 9, 10, 13, 17, 20, 21, 22, 23, 24*, etc.). In a case of paroxysmal tachycardia (not included in the series), the digitalis seemed to have an effect upon attacks of migraine, rendering them much more severe.

In several cases that have come under my care there have been curious cerebral attacks, while the patient was under the influence of the digitalis, and I venture the supposition that they were the result of digitalis. A young woman (pregnant) who was taking digitalis, and in whom partial heart-block was present, was seized with an attack resembling ambulatory epilepsy. She was busy with her household duties one morning, and she lost all knowledge of her surroundings until she recovered consciousness and found herself sitting by her sister's fireside, about a mile from her own home, weeping. *CASE 3* lost her memory for a few hours, and *CASES 12* and *39* became aphasic for several hours, while under the influence of digitalis. *CASE 38* lost his memory and talked incoherently for a couple of days, while under the influence of digitalis. All these cases completely recovered, and there were no after effects.

Effect on the urinary flow.

In the records of the quantities of urine excreted, there is a striking variation in the quantity from day to day, while the patient was on no drug. Great care was taken to make these records reliable. A study of the tables shows that it was only in exceptional cases that (as *CASES 2, 8, 27, 28*), there was a marked increase in the flow of urine and, with the exception of *CASE 8*, these showed signs of renal inefficiency by the presence of dropsy. It is possible that the urine increased in some instances, but the fluctuation when without digitalis was so great that a definite conclusion cannot be drawn.

The cases showing an increased discharge of urine are too few to allow any definite conclusions to be drawn with certainty, and many more cases must be observed. However it is of interest to note that when the rhythm is normal the increased flow occurs without any definite alteration in the heart's rate.

In *CASE 27*, a patient in whom the normal rhythm was present, the increase in the flow of urine began after he had taken one to two drachms with no perceptible change in the heart's action. There was a distinct relief from suffering, with the onset of the increased flow of urine. In *CASE 28* (normal rhythm) there was a slight increase in the flow after two to three drachms had been taken, and a very marked increase after four drachms had been taken. Here also the change occurred with no simultaneous decrease in the pulse rate or remarkable improvement in the patient's condition. In *CASE 2* (auricular fibrillation) a slight increase in the flow of the urine occurred after five drachms of the tincture had been taken and after the pulse rate had fallen. In *CASE 8* (auricular fibrillation) there was a slight increase the day after he started the digitalis, but the most marked increase occurred after he had taken about 6 drachms, and was coincident with the great decrease in the heart's rate.

Blood pressure.

In taking observations of blood pressure, the systolic pressure was alone recorded. We found that no result of sufficient accuracy could be obtained when the pulse was continuously irregular, the beats varying so much in strength. We therefore gave up the attempt to register the blood pressure in cases of auricular fibrillation, for though some sort of result could be obtained, the result would be expressed by a figure, and this would have given an aspect of precision, which it did not possess, and would therefore inevitably mislead. We confined our observations on blood pressure to patients with a regular heart action, or in patients with occasional irregularity, in whom there were regular periods of sufficient length for an observation to be taken. As a slight difference in the results obtained by different individuals was noticed, observations in any given case were taken as a rule by the same individual, and always by one of ourselves; observations by the nursing staff were found to be unreliable. The accuracy of our observations was repeatedly tested by compressing the arm and obliterating the pulse, while the radial pulse was graphically recorded, and observing when the lever moved on the return of the pulse while the arm bag was being deflated. We also made numerous confirmatory observations by Korotkoff's auscultatory method. Many of the records are not as complete as they might have been, but such as they are they show that a usual conception of the effects of digitalis on blood pressure is not justified. As a result of experimental observation, it has been assumed that digitalis causes arterial constriction, and in consequence, a rise in blood pressure. But in our observations, even when the drug was pushed and caused nausea and heart irregularities, we could detect no appreciable effect upon the blood pressure, except in *CASE 28*. Some observers believe themselves able to recognise changes in the arterial wall due to digitalis, by means of the finger, but we failed to detect any change. Our conclusions, so far, are that medicinal doses of digitalis do not affect the arterial walls, or if they do so, their effect is so slight as not to be recognisable.

RELATION TO DIFFERENT CARDIAC MECHANISMS.

Auricular fibrillation.

I have already stated that in order to appreciate the results arising from the administration of digitalis in the human subject, it is necessary to recognise the nature of the ailment from which the patient is suffering, and more particularly the lesion affecting the heart. It is in cases of auricular fibrillation that we find that digitalis has the most powerful effect upon the heart.

Symptoms of auricular fibrillation. The clinical signs by which we recognise auricular fibrillation are the following :—(1) The rhythm of the heart in the great majority of cases is continuously irregular. This irregularity is of a disorderly character, (see Fig. 3, 15, 18). Exceptions are found in certain cases of slow action of the ventricles, arising either spontaneously or from digitalis, where the irregularity is only very slight. (*CASES 1* and *3*). (2) All signs of the normal auricular contraction disappear; (*a*) In mitral stenosis with auricular fibrillation, the presystolic murmur attributed to the auricular systole disappears. In many of these cases there is a diastolic murmur resulting from the stenosis of the mitral orifice. This murmur persists, for it is not due to the auricular systole, but to the inrush of blood from auricle to ventricle at the end of ventricular systole. (*b*) The absence of auricular contraction is best shown in the graphic records. The ventricular form of the jugular pulse with irregular heart action, is proof of the presence of fibrillation in the vast majority of cases. (3) In jugular tracings a series of small oscillations in the veins between the ventricular systoles (Fig. 4, 21, 48) may appear, and these are characteristic of auricular fibrillation. Sometimes these waves are of a fair size, and one falling before the *c* wave may simulate a normal auricular wave. Finally an electrocardiogram of a heart with auricular fibrillation shows no sign of the normal auricular systole, but only the small waves peculiar to the fibrillating auricle (Fig. 53, 54 and 55). For fuller evidences of fibrillation of the auricle, see Lewis's article in this journal.[9]

Comparisons of the effects of digitalis in cases with the normal rhythm and in cases with fibrillation. In a series of observations which I conducted, and which extended over many years, practically all the cases in which marked slowing of the pulse occurred were cases of "*Nodal Rhythm,*" as I then termed auricular fibrillation. When one reads critically the accounts of cases in which marked slowing of the pulse has been noticed, from the days of Withering to those of quite recent date, we can infer with fair certainty that these striking diminutions in rate occurred in cases of auricular fibrillation. The records usually state that "the pulse was rapid and irregular," and this, taken with the account of the extreme state of heart failure, is in my experience typical of cases of auricular fibrillation. In the few instances where graphic records have been given to illustrate the slowing of the rate due to drugs of the digitalis group, they all show the characteristic irregularity of auricular fibrillation, (Binz,[3] Morison,[15] Hay,[8] Bailey[1]).

Amongst the cases under our care in the Mount Vernon hospital, the majority which showed evidence of extreme heart failure, accompanied by orthopnœa, dropsy and rapid heart action, were cases of auricular fibrillation; and it was in these cases alone that we obtained remarkable alterations in the heart's rate in response to digitalis. In cases where the rhythm was normal and regular, there was only a slight reduction in the rate in the great majority of cases. In only two cases with the normal rhythm was there marked slowing (*CASES 24* and *25*), and it will be seen that the rate was a moderate one before the administration of digitalis. In cases with apparently similar valve lesions, the difference between those with the normal rhythm and auricular fibrillation is very striking. In order to bring this out clearly, I have taken a series of patients with auricular fibrillation and stenosis of the mitral valve, and have grouped their pulse rates for ten days, beginning with the day on which digitalis was first administered. I have divided each daily total by the number of patients, and have charted the results (Fig. 1, with solid dots). I have taken an equal number of patients with mitral stenosis, but where the rhythm was normal, the auricle preceding the ventricle in the normal manner, and I have charted the results in the same way. These are shown by the thin line with circles in Fig. 1. It will be seen that there is a very marked difference in the reaction of the two groups.

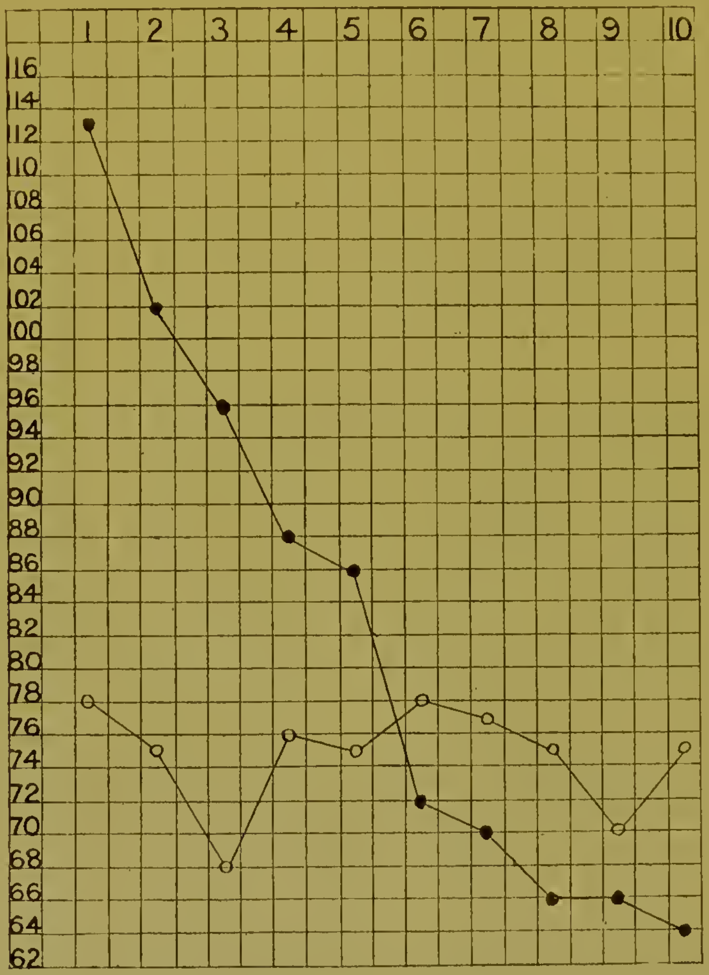

Fig. 1. Chart comparing the effect of digitalis in cases having auricular fibrillation and with those having a normal rhythm. The black dots represent the rate with auricular fibrillation and the white with the normal rhythm. The side figures represent pulse beats, the top figures represent days.

In the one group the fall in rate is speedy and continuous, in the other the effect is very slight. In both groups the digitalis was pushed until there were gastric disturbances, and in both groups the quantity producing this gastric disturbance was practically the same. Before the administration of the digitalis the patients in the first group were all very ill, some of them in great suffering, those in the second group were not so distressed. The records of these cases are given, those of the first group being the patients described in *CASES 1* to *6*, and those of the second group, *CASES 18* to *23*. It is not for a moment intended that this representation should be taken as correct in every particular, but it will be found to be broadly true and to prevail so widely that we are justified in concluding that, in their reaction to digitalis, auricular fibrillation cases are apart from all others as a class.

This view has been strengthened in the study of other cases which have been observed. In *CASE 17* for instance, where there was mitral stenosis, the rhythm was normal while under observation, except for four days when she had auricular fibrillation, provoked in all probability by the digitalis. In the chart (Fig. 29) her pulse rate is shown on two occasions when digitalis was given until nausea appeared. During the first period there was no effect on the pulse rate, which varied between 72 and 94 beats per minute. During the second period the rate continued unaffected for seven days, when it suddenly fell to 56 beats per minute. The heart at the same time became irregular in its rhythm, the auricular wave disappeared from the jugular pulse and the tracing from the neck showed the features characteristic of auricular fibrillation (Fig. 27). The presystolic murmur disappeared. Suddenly on the fourth day of this abnormal action, when I was examining her, the normal rhythm was restored and at once the rate became greatly increased, the rhythm became regular and the presystolic murmur reappeared. There can be little doubt that the difference in the rates was due to the powerful action of digitalis on the heart during auricular fibrillation, and that the heart is far less sensitive to the action of digitalis when its contraction begins with the normal action of the auricle.

Elsewhere I have recorded a similar experience,[12] where auricular fibrillation seemed to be induced by digitalis, and the rate was slow. On stopping the digitalis the heart reverted to the normal rhythm, but a few months later the auricular fibrillation returned, when the patient was not under the influence of digitalis and the rate was rapid.

Cases of auricular fibrillation unaffected by digitalis. There are cases of auricular fibrillation in which the action of digitalis has little or no appreciable effect. In cases where fibrillation comes on in patients suffering from the degenerative changes of later middle life or accompanying advanced years, digitalis is often without effect upon the heart's rate. I have pushed digitalis in such cases until digestive disturbances were induced (sickness and diarrhœa), but without effect upon the heart. Among the cases given here, we had only one such senile case, and in him there was only slight heart failure. There was only a temporary slowing of the heart for one day while he was nauseated by the drug (*CASE 15*). *CASE 14* showed a similar limited response to digitalis. In febrile cases with fibrillation or where there is a persistence of some toxic affection, digitalis is often without effect; one case of this kind is recorded here (*CASE 13*).

Cases of auricular fibrillation susceptible to digitalis. The cases in which the reaction is most frequent are those with a history of rheumatism. As a rule the reaction is best seen in the young with fibrillation, but we have had very good results even in the elderly. Fibrillation arising with no previous history of rheumatism can be shown to react markedly to digitalis (*CASES 6* and *11*).

The character of the slowing varies. In *CASES 1* and *3* the heart became more regular in its action, in the former when the rate was between 40 and 50, in the latter when it was more rapid. In a few cases (*3*, *5* and *9*), there was a tendency for the ventricle to beat in coupled fashion, occasionally with three beats linked together. As a rule the slowing of the heart rate was accompanied by no marked diminution of the disorderly character of the rhythm.

Coupled beats. The case of coupled beats is of interest, for this reaction has long been recognised though the class of case to which it is limited has not been recognised. In rare cases with a normal rhythm, extrasystoles occur regularly, alternating with a normal beat. In auricular fibrillation there is no longer a dominant sinus rhythm and the ventricular rhythm is disorderly before the onset of the coupled beats. Before the coupled beats appear each ventricular beat usually gives an electrocardiogram characteristic of the normal ventricular contraction. When the coupled beats occur, Lewis has pointed out that the second and smaller beat is of anomalous form and that it arises from some part of the ventricle (see Fig. 54). The rhythm during the period of coupled beats is not quite regular, the interval between the first beats of the couples continually varies, though at times it may vary little. When the coupled beats set in the rate of the pulse alters. If the normal beats are alone counted, the rate falls at once to nearly half, though not quite. If the normal and premature beats are counted, then the rate is increased. Thus in *CASE 5*, just before the onset of a period of coupled beats, the rate was usually 65, and with the onset of the coupled beats, the rate was 70.

Cases peculiarly susceptible to digitalis. There are some cases with a peculiarity in their reaction to digitalis which separates them from all others. Thus in *CASE 5*, a girl aged 17, the susceptibility to digitalis was very marked. When the digitalis was stopped, she always relapsed, in a few days the pulse rate increased and the distress in breathing became so great that she had to sit up in bed, and she looked extremely ill. In a few days the exhibition of the digitalis quite restored her, so that she could lie in bed with comfort, and even get up and walk for short distances. The improvement always occurred when the ventricle took on the coupled rhythm. The peculiarity in this case was that when the heart became rapid in its rate, when it had escaped from the digitalis, it sometimes became quite regular. At the time this happened, the breathing was so distressed that we could not get a tracing of the jugular pulse, but when the rate of the heart slowed it was always found to be of the ventricular form. While I have seen numerous patients with this tendency to coupled beats I have only seen two other cases which showed such peculiar susceptibility to digitalis and such a marked tendency to coupled beats, with the heart becoming regular when it escaped from the influence of the digitalis. These two cases were also in the young, a boy aged 12 and a girl aged 16, and in both there was a ventricular venous pulse during the irregular rhythm of the heart. I have reported these cases elsewhere [13, 14].

It is to be noted that *CASE 3*, which showed a tendency at times to coupled beats was also very much better when she was under the influence of digitalis.

Symptoms associated with the action of digitalis in auricular fibrillation. In many cases one of the most marked features accompanying the reaction of the heart was the great improvement in the patient's condition, and the great relief from distressed breathing and from the general sense of discomfort. In many cases there was a good deal of discomfort for a day or two while the patient was nauseated, but with the stopping of the digitalis the nausea ceased and the patient felt remarkably well.

Other changes were observed in some cases, the face became less blue and oedema of the lungs and legs disappeared. The flow of urine was only increased in those in whom there was dropsy. I had hoped that by careful examination of the heart, we should have been able to detect coincident changes in the size of the heart, but these were so slight in most cases that we failed to get any definite results from our examination.

As a rule the good effect on the general condition only lasted while the heart was under the influence of digitalis, and as the heart escaped, it increased in rate and the field of response to effort became more and more restricted. By giving the digitalis in quantities which kept the heart rate within certain limits (under 70), the patients remained quite comfortable and in some instances they could undertake work entailing a good deal of exertion (*CASE 1*).

Inception of auricular fibrillation under digitalis. *CASE 17*, has already been commented upon; while taking digitalis, the heart suddenly became slower in rate and irregular in its action. The digitalis was stopped and the abnormal action persisted for four days, when suddenly the heart increased in rate and became quite regular. I have also referred to another case where a similar observation was made.

The explanation of the sudden change in the heart's rhythm is that the auricle had fibrillated for these four days. There are many cases where this fibrillation is but temporary, and Lewis [9] has examined such cases by means of the electrocardiograph, and confirmed the clinical diagnosis by demonstrating that the auricle was fibrillating.

In two cases where there was a long period of tachycardia, due probably to the heart's contraction starting at some abnormal place, digitalis carefully pushed induced auricular fibrillation, which lasted for a few days. When it ceased, the heart's contraction resumed its abnormal action in the first instance, and on again pushing the digitalis till auricular fibrillation occurred, the normal action supervened. These cases are briefly recorded here, but will be published later with fuller details (*CASES 37* and *38*). Dr. T. Thompson tells me he has recently observed a similar reaction to digitalis in a case of tachycardia.

Action of digitalis on the rate and rhythm in cases with the normal rhythm.

In cases where there was some cardiac defect, various changes were detected. It may be repeated that in order to detect any alteration in the rhythm, it is necessary to observe the patient after exertion, for when the heart's rate begins to decrease variations in rate and rhythm may arise. When under the influence of digitalis, the sinus irregularity is the most common type. During the slow phases of this irregular rhythm, extrasystoles are apt to appear, and the *As-Vs* interval tends to increase, so that beats may drop out as a result of partial heart-block. In some cases all these irregularities appear when the patient is at rest. Among patients with aortic valvular disease, no decrease in the rate occurs. This is of some importance in view of the opinion expressed by Corrigan[7] and held by many clinicians to-day, that digitalis is a dangerous drug in aortic regurgitation. Corrigan's opinion was based seemingly on theoretical grounds. Accepting the view that digitalis slowed the heart's rate by prolonging the diastolic period he assumed that this increase in the length of the diastole would increase the time during which the blood would flow back from the aorta. Balfour[2] and others have combated this idea, maintaining that to get the good effects it is not necessary to slow the rate so such an extent as to produce dangerous symptoms, and Balfour quotes a case where good effects were obtained in aortic regurgitation from digitalis, where there was dropsy and dyspnœa. While there is no doubt that digitalis relieves distress of breathing and reduces dropsy, it does not necessarily do so by slowing the pulse. The rate of the heart in cases of aortic regurgitation, with the normal rhythm, is not affected or very slightly in my experience, and *CASES 27* to *36* bear this out.

The effect of digitalis in producing heart irregularities.

In patients with the normal rhythm, digitalis has induced irregularities of the heart's action of the following forms :—(1) Sinus irregularities, (2) extrasystoles, (3) partial heart-block, (4) *pulsus alternans.*

(1) *Sinus irregularities.* These occurred in a number of cases. They were best shown when the heart was slowing after exertion. All the chambers of the heart take part in this form of irregularity, and in this it resembles the irregularity so frequently found in healthy young people (youthful type

of irregularity), but with this difference, that in the youthful form, the irregularity is very often respiratory in rhythm, an increase in the heart's rate occurs during inspiration and a slowing during expiration. The sinus irregularity from digitalis usually occurs in phases of variable duration, but has no relation to the respiratory movement.

These phasic variations are of interest because, during the slow periods, other forms of irregularity tend to appear, for example extrasystoles and partial heart-block. These phasic variations with peculiar irregularities in the action of the auricles and ventricles have been carefully studied by Lewis.[10] In a case recorded by him he showed that the intervals between the auricular contractions may be so long that the ventricles occasionally contract in response to intrinsic impulses. I have recorded elsewhere [13] a somewhat similar observation in a patient under the influence of digitalis. In these cases it is to be noted there was a serious lesion of the heart's muscle and the *A-V* bundle was undoubtedly affected. The patient whom Lewis observed ultimately came under our care, and the results obtained by Lewis were again observed while the patient was under the influence of digitalis. The patient ultimately died from pneumonia, and in addition to marked changes in the mitral valve (stenosis) there were changes in the myocardium and in the *A-V* bundle. A similar reaction was detected in *CASE 18*, and is commented upon in the paragraph dealing with heart-block.

(2) *Extrasystoles.* Extrasystoles may be provoked by so many influences that in susceptible cases it might be inferred that digitalis would provoke them also. I had previously observed a few patients in whom digitalis readily provoked extrasystoles, but the cases described here only showed them when there was slowing after an increase of rate from exercise. These extrasystoles were always of ventricular origin, sometimes only occasional, at other times alternating with a normal beat (Fig. 46). An electrocardiogram showed that the extrasystole arose from a stimulus within the ventricle, and to be of the same nature as the premature beat in the coupled beats of auricular fibrillation.

CASES 18 and *33* showed extrasystoles on admission, but they disappeared with the rest. On the other hand *CASES 20*, *30* and *34*, showed extrasystoles but they persisted in spite of rest. Digitalis had no effect even in diminishing their frequency.

(3) *Pulsus alternans.* In my experience the *pulsus alternans* is produced by digitalis but rarely, and amongst our cases only one (*CASE 27*) showed a tendency to it (Fig. 40). I have elsewhere recorded two cases.[13] *CASE 23* had well marked *pulsus alternans* on admission but with rest it gradually disappeared as she improved. The digitalis seemed not to affect it.

Fig. 40 shows these different forms of irregularity as a result of digitalis, namely, heart-block, extrasystoles, and *pulsus alternans*.

(4) *Effect on the conductivity of the auriculo-ventricular bundle.* Digitalis may act on the auriculo-ventricular bundle by increasing the interval between the auricular and ventricular systoles, and may prevent the stimulus from the auricle reaching the ventricle (partial heart-block). When this latter event happens, an irregular pulse of a distinctive type is produced. We find in the literature occasional references to irregularities being produced by digitalis, and there is little doubt that many of them were due to partial heart-block. Unfortunately until recent years, graphic records of the irregularities produced were rarely published, and no certain conclusion can be drawn from the verbal descriptions. In one instance which has been frequently quoted, Brunton[5] gives a tracing of an irregular pulse induced by digitalis, which leaves no doubt of its nature, if the measurement used by Wenckebach be employed.[17] This case was reported in 1865, and since that time has been frequently referred to as an instance where digitalis " quickens the rate, then slows it " ; but the true explanation is that the digitalis had produced a partial heart-block, and that the irregularity was of the same kind as that described in *CASE 27.*

In 1905 I published a case of partial heart-block resulting from digitalis,[13] In this case, previous to the administration of digitalis, there had been a prolongation of the *a-c* interval, and this implied an injury to the *A- V* bundle. In a number of cases, observed since then, in which there had been a wide *a-c* interval, digitalis had this same effect with the exception of one case where a curious standstill of the whole heart was produced.

Among the cases observed at Mount Vernon Hospital partial heart-block was produced by digitalis in six. In only one, not included in this series, was there a wide *a-c* interval before the administration of digitalis, and in this instance heart-block was produced on several occasions by digitalis. The changes due to digitalis in this patient have been described by Lewis elsewhere.[10] This patient subsequently contracted pneumonia and died, and a lesion was found affecting the *A- V* bundle. In the remaining five cases (*CASES 17, 18, 21, 24, 27*), the increased interval on digitalis was not constant, but occurred at intervals, and was usually accompanied by dropping out of ventricular beats, giving rise to irregularities in the pulse. In *CASE 27* these periods of irregularity in the pulse resulting from partial heart-block were produced on three occasions, and while they were present the patient's condition was distinctly improved. In tracings of the jugular pulse it will be observed that there is a very large wave *v*, filling up the whole period of the ventricular systole (Fig. 38 and 39). In most of the tracings from the jugular there was no evidence of the auricular wave, so that the appearance of the jugular pulse was of the ventricular form with regular heart action. At times we were able to get a small wave due to auricular systole, so that in this case we could infer that the auricle was contracting regularly, but that owing to the great engorgement of the right auricle, its force was so slight that it barely communicated a wave to the jugular vein. When the partial heart-block was present, we could occasionally detect a small auricular wave between the large waves, and on the assumption that the auricle was contracting regularly, but that the stimulus occasionally failed to reach the ventricle, the diagrams in Fig. 38 and 39 were constructed. In these figures in addition to the small wave (*a*) between the large waves, a small wave is occasionally perceived on the large wave, which I interpret as due to the auricle contracting while the ventricle was still in systole ; the accompanying diagram, constructed on this view, shows the auricle contracting at regular intervals. This interpretation is confirmed by the electrocardiogram, taken during the period of irregularity when Fig. 38 and 39 were obtained. In Fig. 52 the electrocardiograms of this patient are given, and they show that the auricular systole (*P*) occurred at regular intervals and occupied a varying relation to the ventricular systole (*R*, *T*) ; they confirm the diagram which interprets Fig. 38 and 39.

In the other cases the falling out of the ventricular systoles was not so frequent, but the tracings of the jugular pulse showed a distinct increase in the *a-c* interval. In *CASE 21* the block only occurred after exertion, not at once, but after the heart's rate had become slower.

It is of interest to note in *CASE 27* that, although the ventricular rate (and pulse rate) was slowed, there was no slowing of the auricular rate. This is shown in the chart, Fig. 41, where the solid line represents the auricular rate and the interrupted line the ventricular rate, during the period of partial heart-block.

In all cases when the digitalis was stopped, the ventricular intermissions disappeared in a few days. In *CASE 18* variations occurred in the auricular rate, and when the auricle was acting slowly the ventricle contracted independently of the stimulus from the auricle (Fig. 30). These "phasic" variations with the escaped ventricular beats have been dealt with very fully by Lewis.

It is necessary to draw attention to the effect of digitalis in *CASE 17*. She had digitalis given her on three occasions until nausea was produced. On the first occasion, no change could be detected in the heart, but on the second occasion she had auricular fibrillation for four days (commented upon at page 287) ; on the third occasion she showed an occasional intermission which on examination was found to be due to partial heart-block, and there was also a delay in the transmission of the stimulus from auricle to ventricle (Fig. 28). I mention this as it may be of some significance in clearing up the obscurity of the production of auricular fibrillation, and the peculiar susceptibility to digitalis..

The presence of heart-block is not necessarily a contra-indication to the use of digitalis. When it is complete, it cannot interfere with the conduction of the *A-V* bundle, for conduction is abolished, and so far there is no evidence that digitalis has any effect on the idio-ventricular rate. *CASE 39* demonstrated complete heart-block, and though digitalis had an effect on his digestive and nervous systems, and upon the urine secretion, it had no perceptible effect on the heart's rate.

Effect of digitalis on tachycardia.

Abnormal increase in the rate may be due to many causes, and the heart's contraction may start at several places besides the normal starting place. Tachycardias with the contraction starting at the normal place are due as a rule to some toxin or fever, such as accompany tubercular disease, alcoholism, acute pneumonia and other febrile complaints. So far I have found such hearts unaffected by digitalis, even when it is pushed to the extent of causing nausea and vomiting. *CASES 41, 42* and *43*, though the increase in rate was not marked, illustrate this experience.

In tachycardias with an abnormal starting place, the most common form is that due to auricular fibrillation. Here the rate rarely exceeds 140 beats per minute and most cases are very susceptible to digitalis, as has already been pointed out. Although none are included in the cases described here, I have had a number who have drifted to a fatal end quite unaffected by the digitalis group of remedies, pushed as far as one dared.

Another group of tachycardias is that in which the rhythm is as a rule quite regular but where the contractions arise in the auricle in some place other than the normal starting place, in the *A-V* bundle or in the ventricle. Usually in these cases, the tachycardia comes in paroxysms lasting for varying periods. In some, the paroxysms tend to become continuous and unless they are stopped the heart is so exhausted that death ensues. So far no remedy has been found for such cases, although occasionally attacks may be cut short by vomiting or pressure on the vagus. In two cases recorded here (*CASES 37* and *38*), the tachycardia had become continuous, and the patients were becoming more and more enfeebled. The steady pushing of the digitalis ultimately restored the normal rhythm, but it is of interest to note that the auricle, when the decrease in rate came on in the first instance, passed into fibrillation. When this occurred the rate became slower than the normal rate and in this respect resembled *CASE 17*, where auricular fibrillation was induced by the digitalis.

Lewis has shown that paroxysmal tachycardia arising in the auricle is allied to auricular fibrillation and the possibility is that the tachycardias in these two cases were of auricular origin, and this may account for their passing into temporary auricular fibrillation.

Effect of digitalis on the heart muscle.

In my previous experience of the action of digitalis, I had failed to detect any constant decrease in the size of the heart in those cases in which great improvement had taken place. As these observations were not as complete as I wished, when we started our observations in the Hospital, the subject of the effect of digitalis on dilatation of the heart was specially studied. I had already confirmed the conclusions made by many observers that patients with dilatation of the heart experienced the greatest benefits from digitalis. Taking the increase in size as an evidence of dilatation, we were careful to note the size of the heart during the whole time the patient was under our observation in all our cases. At first we intended to keep records by means of X ray observations, but this method was found impracticable. We were therefore forced to depend on percussion as our method of observation. As some slight difference in percussion is usually obtained by different individuals, the observations of individual patients were made only by one of my colleagues. The results obtained showed variations so slight and within the limits of error that we could place little reliance on such variations as were noted. Allowing for small errors, the broad fact stands out that in the great majority of cases where the digitalis had an undoubted effect upon the heart, little or no difference could be detected in the size of the heart. Even in such cases as *CASE 1*, where the patient from being a broken down wreck recovered so far as to do heavy work for many hours a day, no difference could be found in the size of the heart. In *CASE 3*, when she had attacks of great dyspnoea with lividity of face and great distension of the jugular veins, no increase could be detected by percussion during these attacks. In this case there must have been some variation in the size of the heart, and we can only surmise that percussion of the heart does not reveal the changes with sufficient precision.

A distinct diminution in the size of the heart was found in *CASE 11*, but here the rest in bed may have been the chief cause.

That changes take place in the heart which we cannot detect is possible, especially in cases where there has been dropsy. But whether the improvement is due to a cardiac, renal or vaso-motor action, we have no data on which to base an opinion.

Effects of drugs to determine the question of vagus effects produced by digitalis.

In certain cases digitalis acts on the heart by slowing the rate and by strengthening the beat. We attempted to find out how these effects were produced by seeking answers to the following questions. (1) Was the slowing the outcome of a direct action on the heart muscle, or an indirect one through stimulation of the vagus? (2) Was the stronger beat due to the longer rest induced by the slow rate or was it also due to an action on the muscle? To answer the first of these questions we tried to decrease the heart's rate by other means. To this end we used aconite as a substitute for the digitalis, as there is a widespread belief in its power of slowing the rate of the heart and some authorities state that in this respect its action results from stimulation of the vagus. In order to ascertain if the decrease in the rate was due to vagus stimulation, we employed atropine to paralyse the vagus action in certain cases where the digitalis had acted on the heart's rate. To find if the action was on the muscle we used helleborein.

Action of aconite. We gave tincture of aconite to a number of patients, and carefully watched for an effect. We began by giving 5 minims every two hours, then increased the dose to 10, and finally to 15 minims. Although the dose was given for several days in many cases, not the slightest effect could be detected. We tried three different preparations, one of them said to be "standardised," and all without effect on the heart or other organs.

At Professor Cushny's suggestion we then used aconitine, and Dr. Price carried out a series of observations on its action. He employed the drug in cases of fibrillation of the auricle in which digitalis was effective. He employed it in numerous cases with rapid heart action, due to fever and other causes, and carefully pushed the drug in such cases till the patient felt tingling of the tongue and skin, and in not a single instance did he get any evidence of a reaction on the heart or blood vessels.

The action of atropine in hearts under the influence of digitalis. In cases where the heart was slowed from the action of digitalis, the effect of the atropine speedily increased the rate, usually to that which preceded the action of the digitalis. The chart (Fig. 2) shows its effect on *CASE 1.* In this patient the heart rate when free from the effect of digitalis was usually about 80 per minute. Under the influences of small

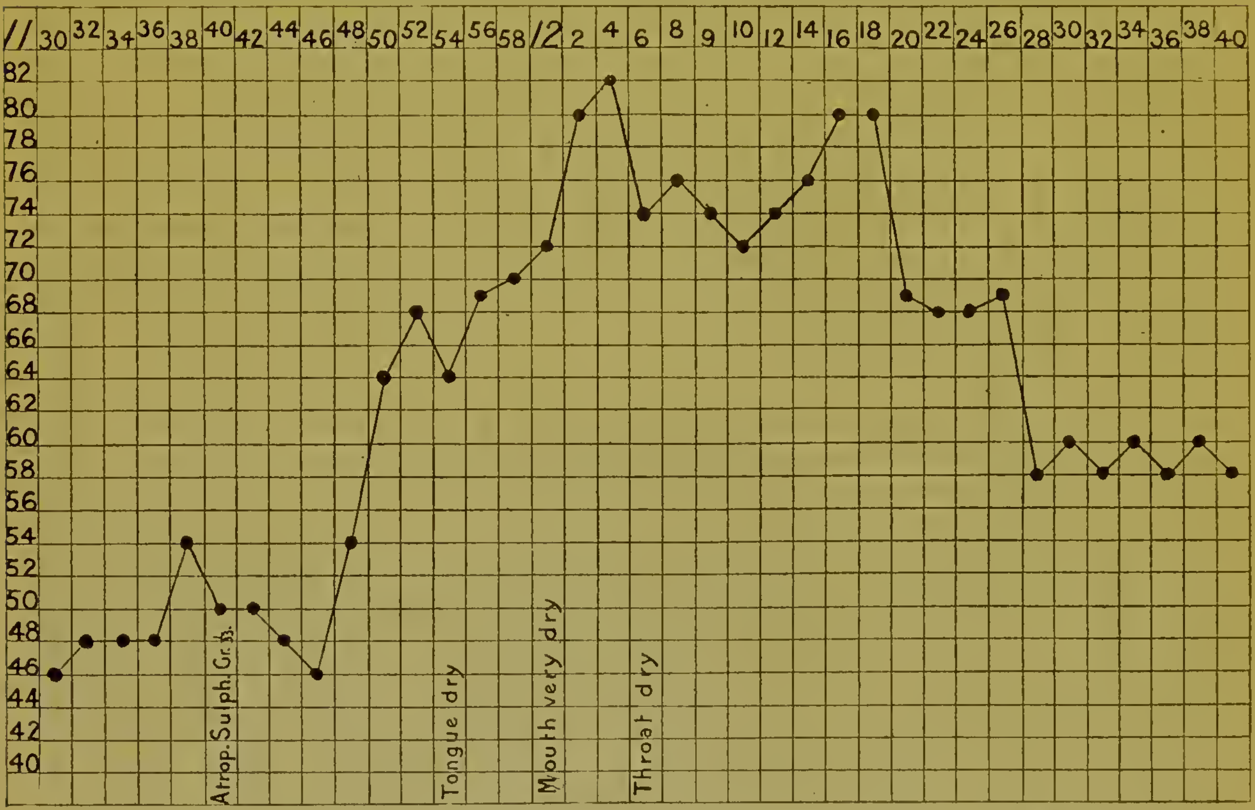

Fig. 2. Chart of *CASE 1,* showing the effects of atropine on a patient under the influence of digitalis. The numbers at the side represent pulse beats, those at the top minutes.

doses of digitalis it could be kept between 40 and 50 beats. The effect of atropine was tried after he had been taking small quantities of the tincture of digitalis for months. The pulse was fairly regular and its rate was 44 per minute before the injection of 0·03 grains of atropine. In six minutes the rate began to rise, and reached 82 per minute—the rate usually present when free from digitalis—24 minutes after the injection of atropine. The effect began to pass off 40 minutes after the injection, but at the end of the hour during which I took a continuous tracing by means of the ink polygraph, it had not quite passed off (Fig. 2). Dr. Silberberg carried out a series of observations on a number of patients under the influence of digitalis and all confirmed this result. In *CASE 5*, when there were continuous coupled beats, the atropine abolished the coupled rhythm. In *CASE 27*, when partial heart-block was present, and the ventricular rate was 84 per minute, the atropine abolished the block and the ventricular rate rose to 110-120.

So far as our observations go, the action of atropine in increasing the rate, when it has slowed, seems to indicate that digitalis acts through the vagus nerve, both in the slowing which occurs in auricular fibrillation and in partial heart-block. This is supported by the fact that it is sometimes possible to produce partial heart-block by pressure of the vagus in the neck, while an observation of mine revealed partial heart-block in a patient under the influence of digitalis whenever he swallowed—the heart block being of the same nature as that which appeared spontaneously when he was more fully under the influence of digitalis. Later observations show that there are other influences at work in slowing the rate.

The effect of drugs allied to digitalis.

Helleborein. Cushny states that helleborein acts on the heart muscle by strengthening the beat. At his suggestion, we tried the drug in cases susceptible to digitalis, but we could get no perceptible effect, although some of the patients stated that they were more conscious of the force of the heart beat.

Strophanthus and squills. An attempt was made to compare the efficiency of other members of the digitalis group of remedies with digitalis. In my experience, I had found that if digitalis failed to act beneficially, these other drugs also failed. Inasmuch as digitalis was sometimes badly borne, causing nausea and headache, it seemed that strophanthus, squills or helleborein might prove free from these unpleasant effects.

So far this hope has not been realised, but our observations are too few to settle the matter.

Strophanthus. The preparation used was the B. P. tincture and in those cases in which strophanthus acted on the heart, slowing its rate, we found digitalis also acted. We found no case in which digitalis failed and strophanthus succeeded. Auricular fibrillation cases, such as *CASES 7* and *9* were very susceptible to strophanthus, two to four drachms markedly slowing the heart. On the other hand, *CASE 10* took forty drachms (1-2 drachms per day) with only slight effect upon the heart. Strophanthus had, like digitalis, only a slight effect upon the heart's rate with the normal rhythm. It is in its action on the digestive tract that strophanthus is so variable. While some patients took as much as 23 drachms (*CASE 25*) and 40 drachms (*CASE 10*) with no intestinal disturbances, others (*CASES 7, 9, 19* and *26*) had diarrhœa, sometimes severe, after 2-6 drachms. (The preparation used was physiologically assayed by Professor Cushny, who found it twenty times stronger in its effect on the exposed heart of the frog than the digitalis we used. But in view of the fact that Cushny has found that the tincture of strophanthus loses its effect when mixed with water we have to repeat our observations.

Squills. The preparation used was the B. P. tincture. As a rule squills had little effect upon the heart. Like digitalis, it caused headache, but only when large doses were taken. Thus *CASE 7*, who at first suffered much from headache when digitalis slowed the heart after seven or eight drachms had been taken, took 19 drachms of tincture of squills with little effect on the heart, but it caused headache. *CASE 9*, who was susceptible to 2½-4½ drachms of tincture of digitalis took 48 drachms of tincture of squills, with only a slight effect on the heart, but severe diarrhœa. *CASE 3*, who was very susceptible to digitalis, took one drachm of tincture of squills for twenty days with no effect. In those patients with the normal rhythm (*CASES 30* and *33*), who took 11 and 20 drachms respectively, there was no effect. On the other hand, *CASE 24* had partial heart-block and extrasystoles after 10 drachms, though she continued to take the drug with no disagreeable effect until she had taken 20 drachms (see Dr. Turnbull's analysis of these cases.[16])

DETAILED REPORTS OF CASES.

CASE 1, male, aged 24. *Auricular fibrillation. Mitral stenosis. Rheumatic history. Marked improvement in general health and slowing of rate after digitalis.*

Admitted February the 8th, 1910. Complaining of weakness, shortness of breath and palpitation.

History. The patient had had two attacks of rheumatic fever at 12 years and 18 years of age. After the last attack, he was told his heart was affected, and he had been giddy and short of breath at times ever since. He had not been able to work for a year, and had lain in another hospital for four months before admission to the Mount Vernon Hospital.

State on admission. The patient's breathing was rapid (22-30) and laboured; he lay propped up in bed. The pulse was continuously irregular and the rate varied from time to time during the examination; at one time it was 117, and at another time 78 (Fig. 3). There was a large area of cardiac pulsation of the 3rd, 4th, 5th and 6th interspaces, the most prominent beating being in the 5th space outside the nipple line. The margins of the heart's dulness lay 1½ and 6 inches to right and left of the middle line. There was a systolic murmur, heard loudest at the apex. Here there was also a soft short murmur following the second sound. At the base the second sound was markedly reduplicated and no murmur was heard. The liver was enlarged and could be felt to pulsate three inches below the level of the ribs.

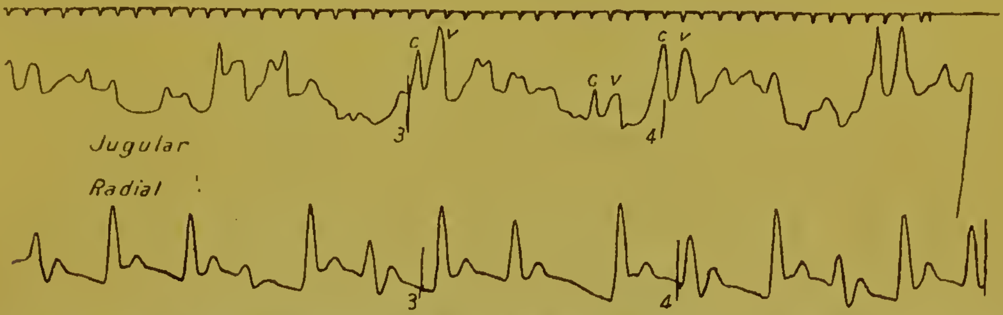

Fig. 3. Simultaneous tracings of jugular and radial pulses from *CASE 1.* The irregularity is characteristic of auricular fibrillation, the rate is 78 per minute; the patient was not under the influence of digitalis.

Treatment and progress. The patient was treated by rest only for ten days, and made a slight improvement, though he at once became worse if he walked a few yards. On February the 19th, he was put on 15 minims tincture of digitalis, four times a day. Under the influence of the drug the pulse became slower, and in a few days the patient's condition rapidly improved. After he had taken 11 drachms, there was a good deal of nausea, and the drug was stopped on March the 2nd. The nausea disappeared in a few days and the patient felt much better. The pulse remained slow and almost regular (see Fig. 4), though there was no return of the normal rhythm. On March the 9th the pulse rate began to increase. He was put on helle-

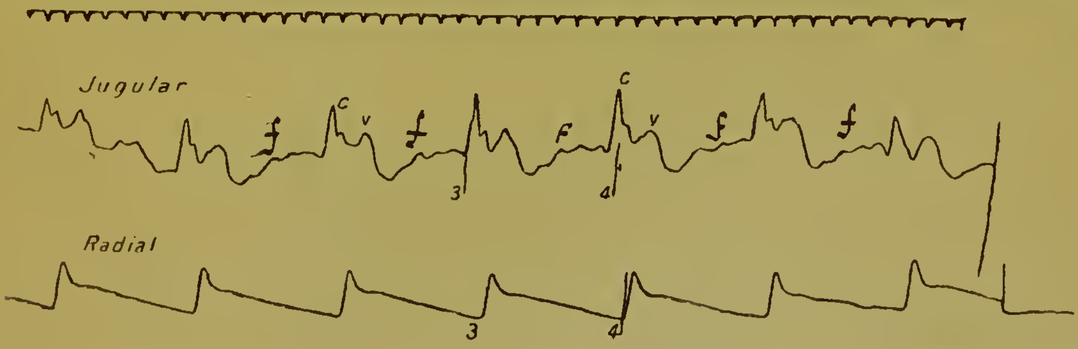

Fig. 4. From the same patient as Fig. 3 (*CASE 1*) after 10 drachms of tincture of digitalis. The pulse rate is 42. The jugular tracing shews the series of small waves (*f*) characteristic of fibrillation.

borein on March the 13th in doses at first of $\frac{1}{6}$ grain, and later $\frac{1}{2}$ grain, six times a day, till March the 21st, when the drug was stopped for a day or two as the rate of the heart continued to rise, and there was at times a distressing flutter of the heart. The helleborein was resumed on the 22nd in doses of $\frac{1}{2}$ grain three times a day, but diarrhœa set in and the drug was stopped after a couple of days, 15$\frac{3}{4}$ grains having been taken in 13 days. The pulse rate became very irregular and increased in rate, continuing from 74 to 82, and the patient was very breathless and weak on exertion. On April the 1st he began again with the digitalis, 15 minims four times a day, and this was continued till April the 11th, when he had taken 10 drachms. His pulse rate had fallen under 50, and was almost regular, and he felt much better and breathed more easily, but as nausea appeared, the drug was stopped for a few days. When the nausea had passed off, he felt very well, and on April the 13th, the digitalis was resumed in doses of 15 minims thrice daily. This quantity kept the pulse rate between 45 and 50 beats per minute, without producing any disagreeable symptoms. He felt very fit when discharged from the hospital on May the 29th, and resumed his work (see Fig. 5).

On November the 13th, 1910, he called to report himself. For a month after leaving the hospital he had taken 30 minims of tincture of digitalis daily. During the second month 15 minims once a day, and after that he had taken three or four doses of 15 minims a week, sometimes going several days without any medicine. The indication which guided him was his pulse rate, if it was about 50, he was well, but when it began to get rapid after exertion he took a few doses of his digitalis and felt quite well again. While the digitalis kept the pulse slow, he was quite fit for work (organ grinding). The organ is a heavy one, and he drags it himself, sometimes as far as 20-25 miles a day, and he seldom leaves off before 7 p.m., with the exception of half hour for dinner. When examined his pulse was 54 per minute, fairly regular for short periods, but showing in the jugular the characteristic signs of auricular fibrillation.

On December the 15th he called on me, and was still working and feeling very well. The heart rate was usually from 45 to 50 per minute. Occasionally it increased in rate, and the heart "fluttered," but a dose of digitalis always slowed it down. The last few weeks, prior to seeing me, he had taken about 1 drachm of the tincture per week. After recording the pulse rate for about 10 minutes, a hypodermic injection of atropine sulphate containing 1-33 grain was given. The pulse rate was graphically recorded for one hour after. In 6 minutes the rate increased, reaching 80 about 20 minutes after the injection. It continued at this rate for about 20 minutes and then fell to about 60 for the remaining 20 minutes he was under observation (Fig. 2).

It is to be noted that although there was a great improvement, the size of the heart and the nature of the heart's rhythm did not alter, the auricular fibrillation still persisting.

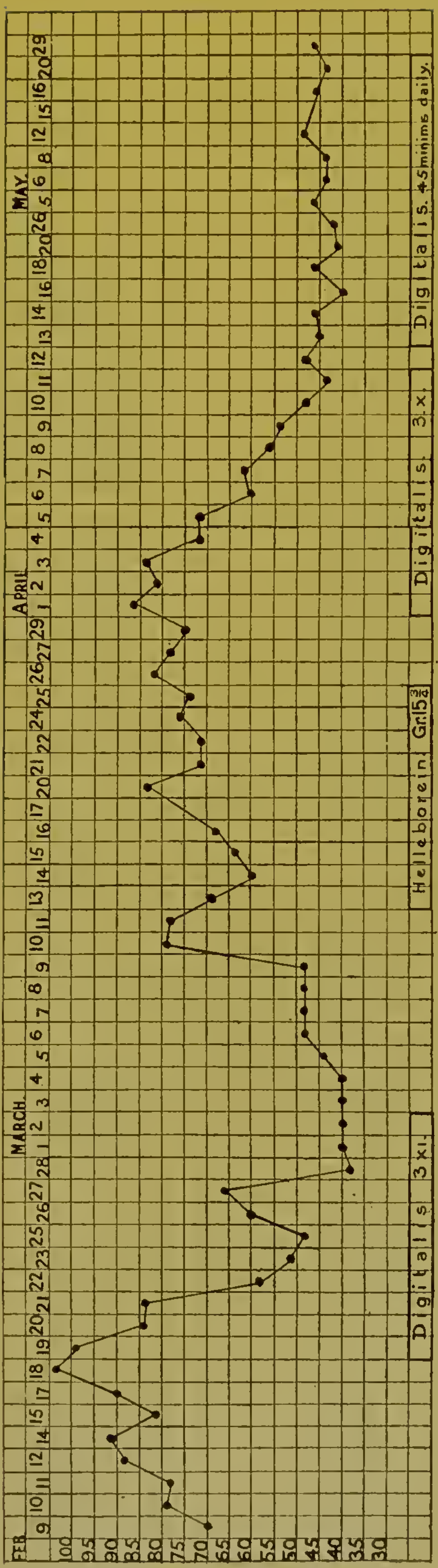

Fig. 5. Chart of *CASE 1*, showing the effect of digitalis, etc. The numbers at the side represent pulse beats, those at the top days.

Date	Drug.	Pulse Rate.	Urine.	Size.	Remarks.
Feb.					
9		70	25		
10		79	53		
11		78	45		
12		88	58		
14		93	44	1½-6	Short of breath, palpitation, pain over precordium, lies propped up in bed.
15		82	58		
17		90	42		
18		108	62		
19	Digit. ʒi p. d.	99	61		
20		84	56		
21		84	53		Not sleeping well, has to sit up two or three times in the night.
22		58	60		
23		52	75		Feels fairly well, nausea.
25		48	61		Feels fairly well, nausea.
26		60	52		Feels "sick at stomach," able to sit up in chair for 1½ hours.
27		66	62		Can sleep lying flat.
28		38	34		More nausea. Can walk about in comfort.
March.					
1		40	52		Feels better, nausea nearly gone.
2	ʒxi Digit. stopped	40	53		Not so well to-day, feels sick at stomach.
3		40	29		Feels queer. Headache. Nausea.
4		40	36		Feels better, no nausea.
5		44	35		Still improved, no nausea.
6		48			
7		48			Feeling well.
8		48			
9		48	40		Not so well, palpitation, short of breath last night.
10		79	53		
11		78	45		Not so well, giddy and dyspnœic, palpitation.
13	Helleborein	69			
14		60	44		Feels poorly.
15		64	54		
16		68	38		Feels poorly, palpitation on exertion.
17			55		
20		84	56		Fluttering of heart and dyspnœa on exertion.
21		72	37	1½-5¾	
22		72	44		
24		76	17		Palpitation on slightest exertion, diarrhœa.
25	Gr. 15¾ Helleb. stopped	74	38		Complains of "thumping" of heart. Diarrhœa.
26		82	60		
27		78	63		
29		75	64		
April.					
1	Digit. ʒi p. d.	87	53	1½-6	Feels as though heart were beating very fast, "thumping."
2		81	65		
3		84	58		
4		72	31		No definite change, except less breathlessness after exertion.
5		72	63		Breathing quite easy in bed.
6		60	47		Feels well, breathing easy, less breathless after exercise.
7		62	70		One minute after exercise, pulse rate fell to 50.
8		56	63		Feels well, breathing easy when quiet. Slight nausea in night but good appetite.

DATE.	DRUG.	PULSE RATE.	URINE.	SIZE.	REMARKS.
April.					
9		54	52		Feels fairly well, slight nausea. One minute after exercise, pulse rate fell to 45.
10		48	46		Feels sick, slight nausea.
11	ʒx Digit. stopped	44	61	1¼-5½	Feels sick, vomited last night. Breathing easy, feels heart thumping occasionally.
12		48	31		Feels very well, though slight nausea. Slightly breathless after exercise.
13	Digit. 45 minims p. d.	45	39		Feels well, slept well, no nausea now.
14		46	40		
16		40	62		Breathing easy, no nausea but feels heart thumping and beating. Pulse fell to 36 2 minutes after exertion.
18		46	47		Feels well, no nausea. Feels heart beating a good deal. Pulse rate fell to 45 5 minutes after exercise.
20		42	34		
26		43	48		No nausea for some days.
May.					
5		46	55		
6		64	66		
8		44	75		Feels well, heart still thumps after exertion.
12		48	66		
15			84		
16		46	79	1¼-5½	Felt a little nausea last night. Breathing easy.
20		44	60		
21			45		Feels well, but heart thumping a good deal.
25			76		Feels well.
29		46	51		Feels well, able to go upstairs in comfort.
Nov.					
13		54		1¾-6½	Feels well and working. (See notes).
Dec.					
15		48			Feels well and working. (See notes).

CASE 2, female, aged 35. Auricular fibrillation. Mitral stenosis. Rheumatic history. Marked improvement and decrease in pulse rate after digitalis. Kept well on small doses. No effect from aconite.

Admitted June the 14th, 1910. Complaining of cough and shortness of breath.

History. She had been short of breath as long as she could remember but had been worse during the few years prior to admission, and sometimes very bad, especially after a period of rest. She had rheumatic fever at the ages of 12, 14 and 17.

State on admission. The patient was well nourished, the face was dusky and the lips dark red. The legs were slightly swollen ; she was able to go about, but was very breathless. The pulse was continuously irregular, 84 beats per minute. The jugular pulse was of the ventricular form. The heart's impact was slight, the apex beat was in the 6th interspace, and the heart's dulness lay 1½ and 6 inches to right and left of the mid-sternal line.

There was a systolic murmur heard loudest at the apex, and a diastolic murmur heard only at the apex.

Treatment and progress. The patient was allowed to rest in bed with no medicinal treatment for a week. During that time the pulse rate fluctuated between 76 and 84 beats per minute. On June the 26th she was put on tincture of aconite, 5 minims every two hours during the day (receiving 8 doses per day). This was continued till July the 4th when the dose was increased to 15 minims every two hours. The pulse had gradually increased in rate, sometimes being as high as 112 beats per minute. The aconite was stopped on July the 7th, the pulse rate being 100 at that date. On July the 8th she was given tincture of digitalis, 30 minims thrice daily, and this was continued till July the 13th, when she had taken 7½ drachms. The pulse had fallen to 60 beats per minute, and there was a good deal of headache and nausea, but no vomiting. The headache and nausea persisted and she vomited on the 14th. She had no appetite. By the 19th all the disagreeable sensations had disappeared and she felt very well, the pulse rate being 60. After that date the patient felt better and the pulse rate fluctuated between 60 and 80 beats per minute till her discharge on August the 4th.

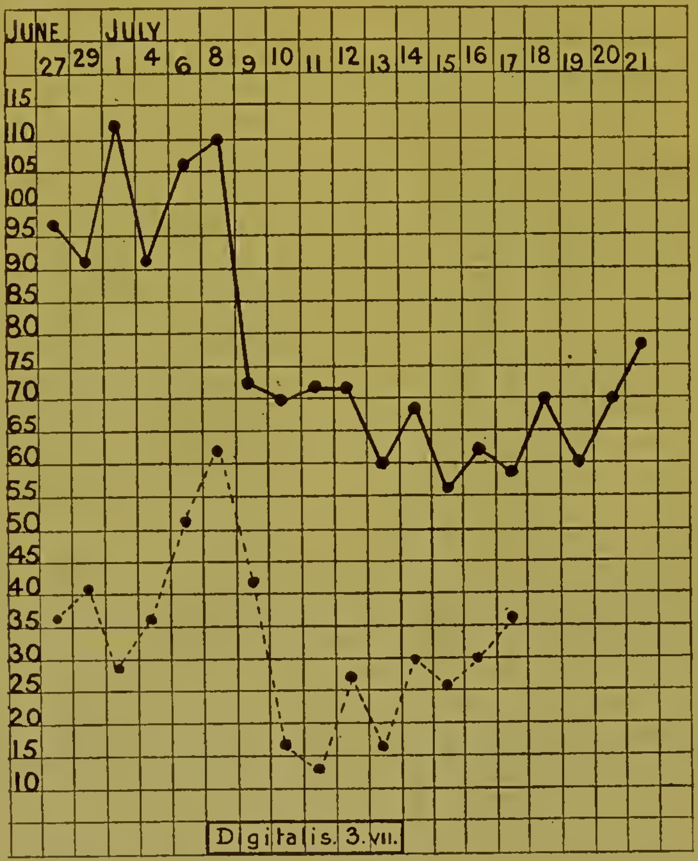

Fig. 6. Chart of *CASE 2*. Showing pulse rate (solid line) and urine flow in ounces (interrupted line).

After leaving the hospital she stopped taking the digitalis and she became gradually more breathless and cyanosed and the legs swelled. She called at the out-patient department on August the 23rd, and was put on tincture of digitalis, one drachm per day, and she improved at once. During November and till December the 7th she took 45 minims of the tincture per day and felt very well on it, and was able to do her household duties. When last seen (December the 7th) she looked much less dusky and felt very well. The pulse rate was 84 beats per minute after walking and sitting down for a few minutes (see Chart, Fig. 6).

DATE.	DRUG.	PULSE RATE.	URINE.	SIZE OF HEART.	REMARKS.
July.					
6		106	37	1½-6	
8	Tr. Digit. 30 minims	110	41		
9	90 minims	73	29		
10	,, ,,	70	37		
11	,, ,,	72	52		
12	,, ,,	72	63		Headache.
13	60 minims	60	42		Headache, nausea, no appetite.
14		68	16	1½-6	Vomited. Headache.
15		57	14		Vomited. Headache.
16		63	27		Better, no vomiting.
17		59	16		
18		70	30		
19		60	26		
20		70	30		
21		78	57		Breathing much easier.

CASE 3, female, married, aged 33. Auricular fibrillation. Mitral stenosis. Rheumatic history. Marked improvement and decrease in pulse rate while under the influence of digitalis. No effect from squills.

Admitted July the 13th, 1910, complaining of shortness of breath, cough and palpitation.

History. The patient had had frequent attacks of "rheumatism" ever since the age of ten. She had known that her heart was affected since she was eleven years old. She had suffered from repeated attacks of heart failure, at times with great distress in breathing, and had been 43 times in hospital; she had been bled 27 times for attacks of "asthma," always with relief. She had been very ill twelve days before admission, with shortness of breath, cough and palpitation.

State on admission. The patient lay propped up in bed, the face dusky, breathing laboured. The pulse was small, irregular and rapid, 114 beats per minute (Fig. 7). The deep jugular veins were distended and pulsating. The chest was somewhat emphysematous, and there were numerous râles all over the lungs. The heart's apex was in the 6th interspace, and the heart's dulness lay 2 and 6¾ inches to right and left of the mid-sternal line. At the apex there was a systolic murmur and a reduplicated second sound, and, when the heart had slowed, there was a well marked diastolic murmur at the apex. The knuckles of both hands were enlarged and the fingers distorted. The liver was three inches below the ribs and pulsated. There was slight oedema of the feet.

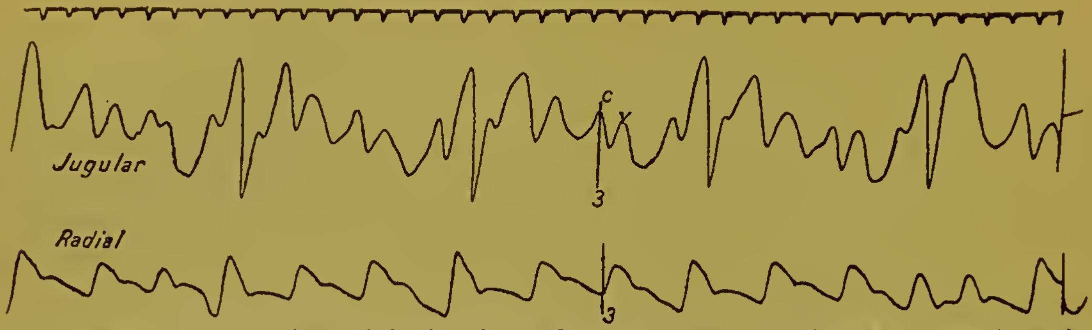

Fig. 7. Simultaneous tracings of the jugular and radial pulses from *CASE 3.* The irregularity is characteristic of auricular fibrillation, the jugular pulse is of the ventricular form, the rate is 104 per minute, the breathing is laboured, and disturbs the tracings of the jugular and radial during inspiration. The patient was not under the influence of digitalis.

Treatment and progress. The patient's distress was so great that she was at once placed on tincture of digitalis, 30 minims three times a day, and this was continued for three days till she had taken 4½ drachms. She began to vomit after she had taken three drachms, and the vomiting continued till the drug was stopped. With the onset of vomiting, the breathing became greatly relieved and the heart's rate fell. The vomiting ceased the day after the digitalis was stopped and the patient was very much better in every way. The patient stated that she was very liable to attacks of breathlessness, but so long as she was under the influence of digitalis she did not suffer from them. She was therefore given digitalis again, 1 drachm per day on July the 30th. After she had taken 4½ drachms (August the 5th) the vomiting returned, and the pulse rate fell (Fig. 8), sometimes it was as low as 46 beats per minute and the drug was therefore stopped. When the heart's rate fell there were frequent periods when the pulse became very slow, and it was found that the heart was beating with the coupled rhythm. By the 10th all the disagreeable symptoms had passed off, the rate rising to 78 per minute, and she was put on tincture of digitalis, 10 minims three times a day. This speedily induced headache and the coupled rhythm of the heart, so that the pulse rate fell to 44 per minute—the rate of the heart being double the

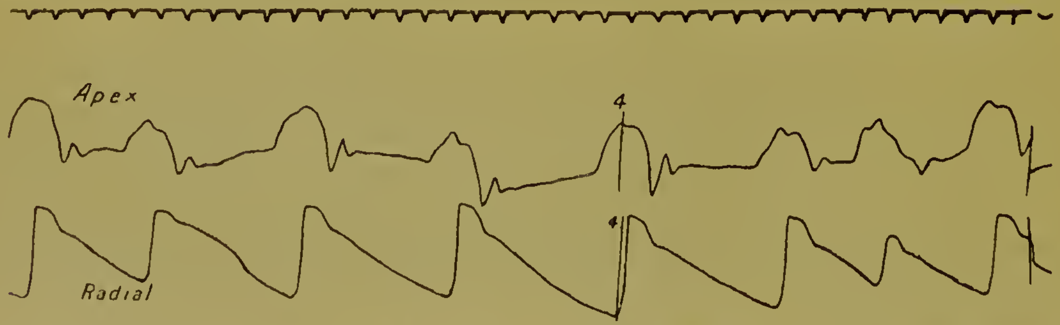

Fig. 8. Simultaneous tracings of the apex beat and radial pulse, from *CASE 3,* after the patient had taken 4½ drachms of tincture of digitalis. The patient had greatly improved, the jugular pulse had disappeared and the pulse rate had fallen to 52.

number of the pulse beats. There was slight nausea on the 13th; the dose was reduced to 10 minims twice daily and this was continued till the 17th, when the patient was painfully conscious of the heart's beat, the coupled rhythm being present and now nearly continuous. The drug was reduced on the 18th to 5 minims twice daily; she woke next morning with a severe headache and mental confusion, in that she could not remember the names of people or things. She vomited and the coupled rhythm was present. The drug was stopped and in a couple of days she was much better and on the 26th there were only occasional periods of coupled rhythm; by the 27th the coupled beat had gone. As the pulse rate was beginning to quicken, she was put on tincture of digitalis, 10 minims twice daily on August the 28th, in three days the coupled rhythm returned and the digitalis was stopped. The coupled rhythm ceased and on September the 7th she was put on tincture of strophanthus, 10 minims thrice daily. On the following day she became gradually worse, the breathing became rapid and laboured, the pulse increased in rate to 132, the respirations were 60 per minute and the patient developed what seemed like a severe attack of asthma. Various remedies were tried to give her relief, but after an injection of morphia and the inhalation of oxygen the attack subsided somewhat rapidly. From this date onwards she was given digitalis in varying quantities, but she quickly responded with some disagreeable symptom and when free from digitalis she was liable to attacks of intense dyspnœa. She had several of these attacks and was bled for them; after 10 to 20 oz. of blood were withdrawn, she was always greatly relieved. The attacks were invariably accompanied by very rapid action of the heart and great distention of the veins of the neck; the pulsation of the internal jugular veins being visible behind the ear. Notwithstanding this evidence of congestion of the right side of the heart no change could be detected in the size of the heart.

From October the 16th to the 31st she was taking 20 minims of tincture of squills four times a day but it had practically no effect on the heart rate or urine secretion, and the attacks of severe dyspnœa recurred while she was taking this drug, so it was not persevered with. She had three very bad attacks on November the 7th, 8th and 9th, and on the 8th she was put on digitalis, at first one drachm a day, then, after three doses, ½ drachm per day. The pulse rate kept between 60 and 64 beats per minute till the 19th, when it began to increase and the dyspnœa returned. The increase of the dose to a drachm per day speedily slowed the heart and relieved the breathing. The rhythm became almost regular (Fig. 53).

The ease and comfort of the patient and the freedom from the dyspnœic attacks, while partially under the influence of digitalis induced us to give her just as much as would produce comfort with the avoidance of disagreeable effects. This was attained by giving her 10 minims thrice daily and intermitting the drug on the first sign of digitalis effect, for example headache, nausea or the coupled beat. Only a portion of the notes are included as they are too voluminous to give in their entirety; but the repeated administration of digitalis always produced effects similar to those described, the pulse increasing in rate as soon as the digitalis effect passed off.

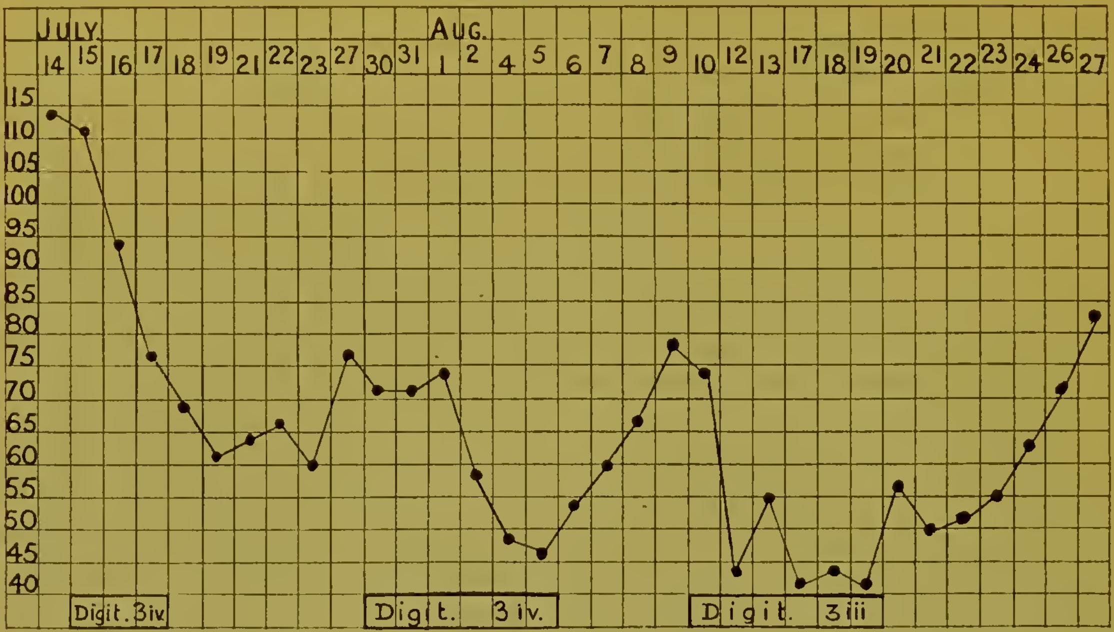

Fig. 9. Chart of *CASE 3.*

DATE.	DRUG.	PULSE RATE.	URINE.	SIZE OF HEART.	REMARKS.
July.					
14		114	20	2-6¾	Very short of breath.
15	Tr. digit. 30 m. p.d.	111	26		Very short of breath.
16	p. d.	94	55		
17	ʒiv Digit. stopped	76	17		Vomiting, breathing easier.
18		69	8	2-5¾	Vomiting, breathing easier.
19		61	26		Vomiting, breathing easier.
21		64	27		No vomiting, breathing easier.
22		66	7	2-5¾	Much better, can lie flat.
23		60	24		
27		77	24		
30	Digit. ʒi p.d.	72	21		
31		72	26		
August.					
1		74	40		
2		58	30		
4	ʒiv Digit. stopped	48	44		
5		46	7		Vomiting and coupled beat.
6		54			
7		60	4½		
8		66	11½	2-6½	
9		78	7		No coupled beat.
10	Tr. digit. 30 m. p.d.	74	38		
12		44	12		
13	20 m. p.d.	55	11		Vomiting, coupled beat.
17	,, ,,	42	22		Coupled beats
18	10 m. p.d.	44	27		
19	,, ,,	42	30	2-6	Headache, loss of memory, coupled beats, vomited.
20		62	27		No nausea, no headache, coupled beats more seldom.
21		55	46		
22		57	36		
23		60	34		
24		68	54		
26		76	20		
27		88	50		

CASE 4, female, aged 29, tailoress. Auricular fibrillation. Mitral stenosis. Rheumatic history. Marked response to digitalis.

Admitted January the 26th, 1911, complaining of great weakness and breathlessness.

History. The patient had rheumatic fever at the age of 8, and gastric ulcer at the age of 18. She had been delicate for years and during the few weeks prior to admission she had been exceedingly weak and ill.

State on admission. The patient lay propped up in bed, with laboured breathing. The face was suffused, and the cheeks were dusky and blotched, the nose and lips blue. The conjunctivæ were slightly jaundiced, and there were dusky blotches on the trunk and limbs. The radial pulse was small, rapid and irregular, its rate was 140 per minute. The heart's dulness lay 1 and 6 inches to right and left of the mid-sternal line. The apex lay in the 6th interspace. There was a systolic murmur at the apex and also a diastolic. The respiration was laboured, the rate being 38 per minute.

Treatment and progress. The patient's condition was of such extreme gravity that she was at once put on tincture of digitalis, 15 minims four times daily. She showed little improvement till January the 30th, when she felt more comfortable, though the heart's rate did not decrease till February the 1st. After that she rapidly improved, and when last seen, on February the 5th, she was very comfortable and bright. She was found to have a chancre, and gave a positive Wasserman reaction. She was removed to another hospital (see Chart, Fig. 10).

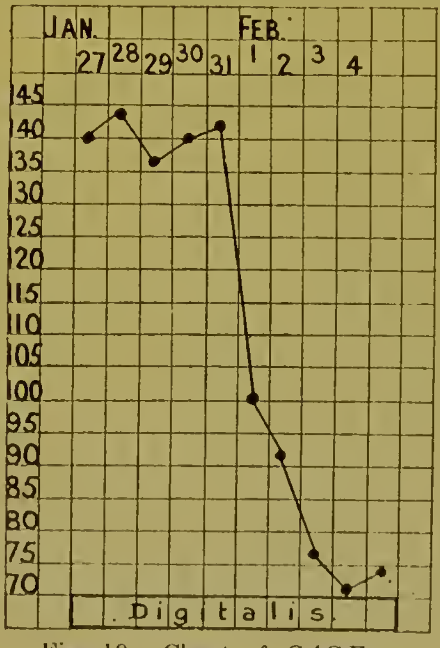

Fig. 10. Chart of *CASE 4.*

DATE.	DRUG.	PULSE RATE.	RESP.	URINE.	REMARKS.
Jan.					
27	Digit, ʒi p.d.	140	38	24	Orthopnœa. Cyanotic.
28		144	32	12	Orthopnœa. Headache. Menstruating.
29		136	28	22	Sleeping badly.
30		140	28	28	Better, more comfortable.
31		142	28	32	Comfortable.
Feb.					
1		100	32	30	Much easier, can lie flat.
2		92	28	30	Cyanosis gone.
3		76	28		Much better.
4		72	26		
5	ʒx Digit. stopped	74			

CASE 5, female, aged 17. Auricular fibrillation. Mitral stenosis. Rheumatic history. Heart very sensitive to digitalis.

Admitted August the 26th, 1910, complaining of great weakness and shortness of breath and palpitation.

History. She had had chorea at 10 years of age, and rheumatic fever in November, 1909, and had never been well since, suffering from great difficulty in breathing on exertion.

State on admission. The patient lay propped up in bed, looked very ill and was extremely emaciated. The face was pallid, the breathing laboured, 50 per minute, the pulse 144 per minute, very small and perfectly regular. The apex beat was in the 6th interspace 3 inches beyond the nipple line. The heart's dulness lay 1 and 6½ inches to right and left of the mid-sternal line. There was a rough systolic murmur at the apex and a systolic and diastolic murmur at the aortic area. There was dulness as high as the scapular spine on the right side of the chest and absence of breath sounds over this dull area. There were numerous râles over the left side behind.

Treatment and progress. Considering the urgent condition of the patient she was at once put on tincture of digitalis, 15 minims four times a day, and this was continued for seven and a half days the patient taking altogether 7½ drachms. There was little change in her condition for three days, when she vomited and after this the pulse rate fell (Fig. 11), and she began to improve and breathed more easily. The vomiting persisted and the pulse rate continued to fall to 45 beats per minute, and the digitalis was then stopped. The vomiting ceased when the digitalis was stopped, but day by day the pulse rate began to increase and, with the increase in the rate, the breathlessness and distress returned. She was again put on tincture of digitalis, 10 minims three times a day on September the 14th and again it speedily slowed the pulse rate but induced vomiting after six days; the drug was stopped on the 19th after she had taken 2½ drachms. On this date the breathing was much better, she could lie flat and the extent of the dulness over the lung was greatly reduced and 10 days later it had disappeared. With the cessation of the drug the pulse again increased in rate and the patient became alarmingly ill on October the 5th. The exhibition of the digitalis again relieved her and after this she was kept more or less under its influence for six weeks, the dose varying with the pulse rate or the condition of the stomach.

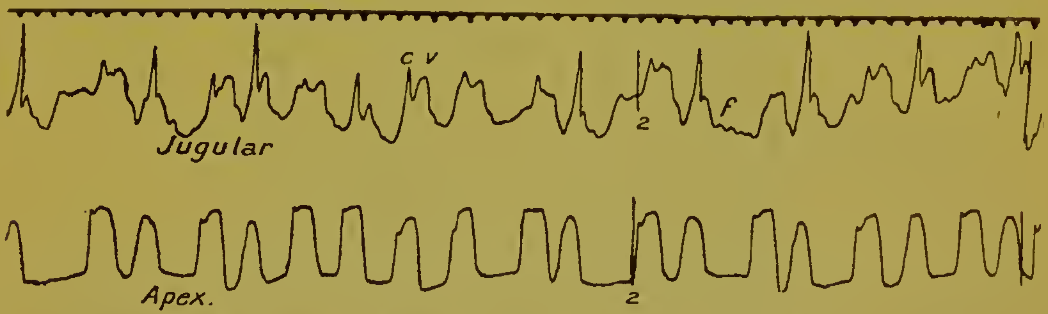

Fig. 11. Tracing of the jugular pulse and apex beat from *CASE 5*, after 7½ drachms of tincture of digitalis. The rate is 96 beats per minute, and the heart shows a tendency to a coupled rhythm. Note the fibrillation waves in the tracing of the jugular pulse at *f*. The patient was free from distress.

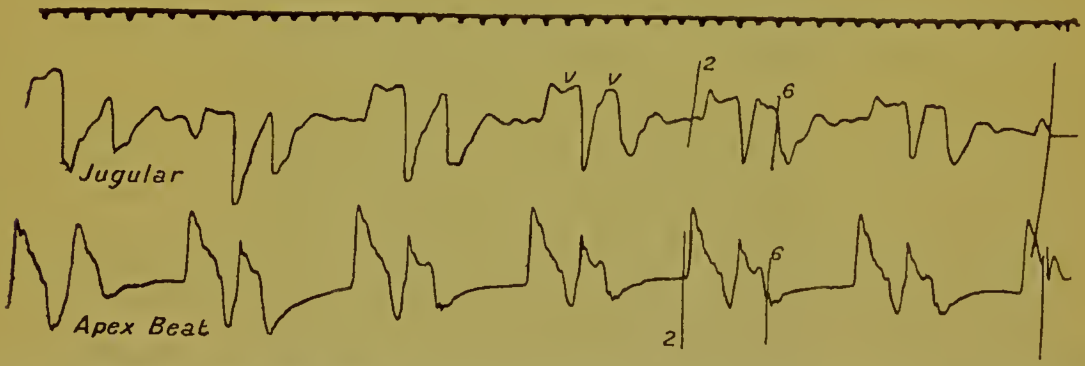

Fig. 12. Tracings of the apex beat and jugular pulse from *CASE 5*, showing the coupled beats maintained by small doses of tincture of digitalis.

From November the 12th she was taking 5 minims of the tincture of digitalis. This was continued till the 18th, and at this date she was feeling much better and was able to sit up out of bed. She vomited and the dose was given twice a day. She vomited on the 19th and the drug was stopped. Next day she felt much better and the vomiting ceased. The heart rate kept down, with long periods of coupled beats (Fig. 54 and 55), when the pulse rate would be between 36 and 40 and the heart's rate exactly double. On the 23rd the heart's rate increased, and on the 25th became very rapid (124) and the patient was very ill (orthopnœa, respiration 50 per minute, crepitations at the base of the lungs). She was at once put on a dose of one drachm per day and the heart speedily reacted, and in a few days she was free from all distress.. Until her discharge on December the 1st, she was kept on small doses of digitalis (10-20 minims per day), and so long as the rate kept under 60 she was very comfortable in bed and able to sit up and walk a few steps (see Chart, Fig. 13).

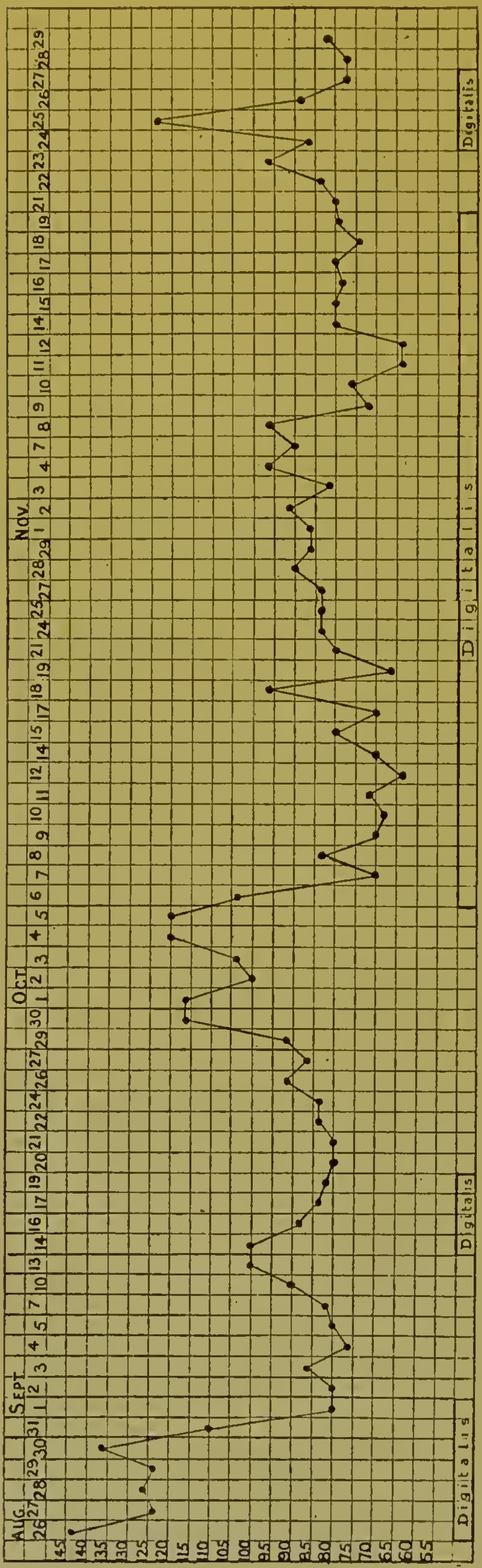

Fig. 13. Chart of *CASE* 5.

Date.	Drug.	Pulse Rate.	Urine.	Size.	Remarks.
August.					
26	Digit. ʒi p.d.	144		1-6½	Very ill.
27		124	28		
28		126	30		
29		124	10		
30		136	12		Vomited.
31		110	20		Vomited, breathing easier.
Sept.					
1	ʒvii Digit. stopped	80	18		Vomited.
2		80	20		Vomited.
3		86	19		Vomited.
4		76			
5		80	20		No vomiting, frontal headache.
7		82	10		No vomiting, breathing easier.
10		90	26		
13		100	20		Very breathless.
14	Digit. 30 minims p.d.	100	15		Very breathless.
16		88	26		Breathing easier.
17		84	20		
19	ʒii Digit stopped	82	15		Breathing easier, but nausea (coupled beats).
20		80	8		Nausea and vomiting.
21		80	10		Nausea.
22		84	8		No nausea.
24		84			
26		92			
27		86	10		Feels much better.
29		92	20	1¾-5¼	Feels much better.
30		116	15		
Oct.					
1		116	16		
2		100	10		Breathless.
3		104	12		
4		120			
5		120	10		Very ill.
6	Digit. 80 minims p.d.	104	12		Very ill.
7		70	12		Vomited after taking one drachm.
8	10 minims t.d.	84	10		No vomiting.
9		70	12		Feels better.
10		68	12		Feels better, breathing much easier.
11		72	10		
12	5 minims t.d.	64	12		Feels well.
14		70	16		
15		80	26		
17		70	12		Coupled beats.
18	5 minims b.d.	96	12		Coupled beats.
19	Digit. stopped	66	6		Coupled beats.
21	5 minims p.d.	80	10		Coupled beats.
24		84	10		Coupled beats.
25		84			
27		84	16		Coupled beats.
28		90			Coupled beats.
29		86	10		
Nov.					
1		86			Feels well, no coupled beats.
2		92			Breathing more hurried, no coupled beats.
3		82			Same.
4	10 minims t.d.	96			Same.
7		90			Feels a little easier.
8		96			Feels a little easier, some coupled beats.
9		72			Same.
10		76			Feels better, coupled beats.
11		64			Vomited twice, feels sick.
12		64			Feels much better, coupled beats.
14	5 minims t.d.	80			Vomited last night, nausea, coupled beats
15		80			Feels sick, no vomiting.

Date. Nov.	Drug.	Pulse Rate.	Remarks.
16		78	Feeling less sick, coupled beats.
17		80	No nausea, some coupled beats.
18	Digit. 5 m. b.d.	74	Vomited this morning, some coupled beats.
19	Digit. stopped.	78	Vomited this morning, feels better, some coupled beats.
21		80	Feels well, no headache, coupled beats.
22		84	Same.
23		96	
24		86	
25	Digit. ʒi p.d.	124	Very ill, orthopnœa, respiration 50.
26		88	
27		72	
28		72	Much better, able to lie down in comfort.
29		76	

CASE 6, male, aged 33. Auricular fibrillation. Mitral stenosis. Syphlitic history. Digitalis decreased the rate, but caused vomiting, which was followed by marked improvement.

Waiter. Admitted August the 25th, 1910, complaining of shortness of breath and cough.

History. The patient gave a history of syphilis and showed a positive Wasserman reaction. There was no rheumatic history. In February, 1910, he became short of breath and his legs swelled and he was treated in a hospital, receiving digitalis and making a fair recovery. He broke down again and was admitted to Mount Vernon Hospital.

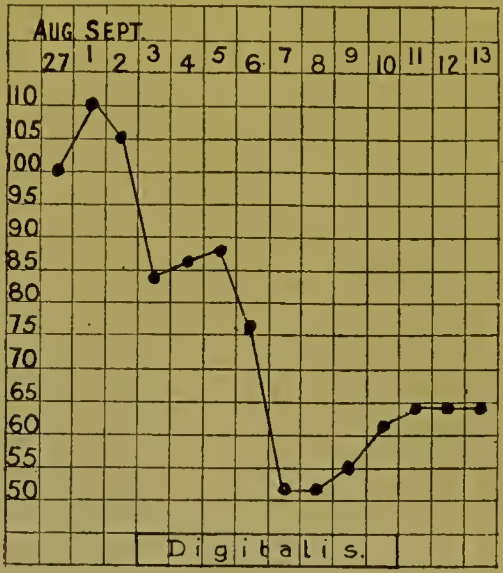

Fig. 14. Chart of *CASE 6.*

State on admission. The patient was pale and spare, and lay with his shoulders raised. The pulse was small, weak and continuously irregular, the rate was 80-100 per minute. The heart's dulness lay 1½ and 4¼ inches to right and left of the mid-sternal line. There was a rough systolic murmur, loudest at the apex and propagated into the axilla. There was also a diastolic murmur at the apex.

Treatment and progress. The patient was very weak and breathless, and after a week's rest he was put upon tincture of digitalis, 20 minims four times a day, on September the 3rd. He speedily reacted to the digitalis, feeling somewhat better after two drachms had been taken, and much better and able to undertake exertion on the 6th, when he had taken 4 drachms. On the 7th he began to be nauseated and he vomited on the 9th after he had taken 8 drachms. The following day the patient felt much better, and his condition keeping good he left the hospital at his own request on September the 14th, feeling fit for work (see Chart, Fig. 14).

DATE.	DRUG.	PULSE RATE.	URINE.	REMARKS.
Aug.				
27		100	51	Short of breath on slight exertion.
Sept.				
1		110	68	
2		105	61	
3		84	63	
4	Digit. 80 m. p.d.	86	63	Much less breathless on exertion.
5		88	66	
6		76	66	
7		52	67	Nausea two hours after each dose.
8		52	65	Nausea, two hours after each dose.
9	ʒviii Digit. stopped	55	66	Vomited three times during night.
10		62	58	Nausea gone, feels better.
11		64	71	Feels well.
12		64	68	
13		64	74	Feels well can walk upstairs without distress.

CASE 7, male, aged 36. Auricular fibrillation. Mitral stenosis. Rheumatic history. Digitalis and squills improved the heart but caused headache. Strophanthus improved the heart but caused diarrhœa.

Carman. Admitted February, 1910, complaining of shortness of breath and swelling of legs.

History. The patient had rheumatic fever at the age of 16. After this he was quite well and worked hard till four years ago, when he noticed his heart beating rapidly. Shortly after this, on carrying a sack of coals, he was suddenly seized with shortness of breath and tightness across the chest and in the pit of the stomach. He had to stop work for a few days, and afterwards was unable to continue long at work; during 1906 he was six months in hospital. Afterwards he was frequently compelled to seek hospital treatment and was admitted to the Mount Vernon Hospital immediately on his discharge from another hospital, where he had lain unrelieved for nine weeks.

State on admission. The patient lay in bed propped up. He became very distressed in breathing if he lay down. His face was of a dusky red. His legs were swollen. The pulse was small and continuously irregular, about 90 beats per minute (Fig. 15). There was swelling and large pulsation of the ventricular form in the jugular veins. When pressure was applied over the liver, the deep jugular vein became enormously distended. The heart was greatly enlarged, the apex diffuse in the 6th interspace. The heart's dulness lay 2 and 7½ inches to right and left of the mid-sternal line. There was a rough murmur, systolic in time, heard loudest at the apex. Here also there was a short murmur following the second sound. The liver was enlarged as low as the umbilicus and pulsated. The liver pulse was of the ventricular form.

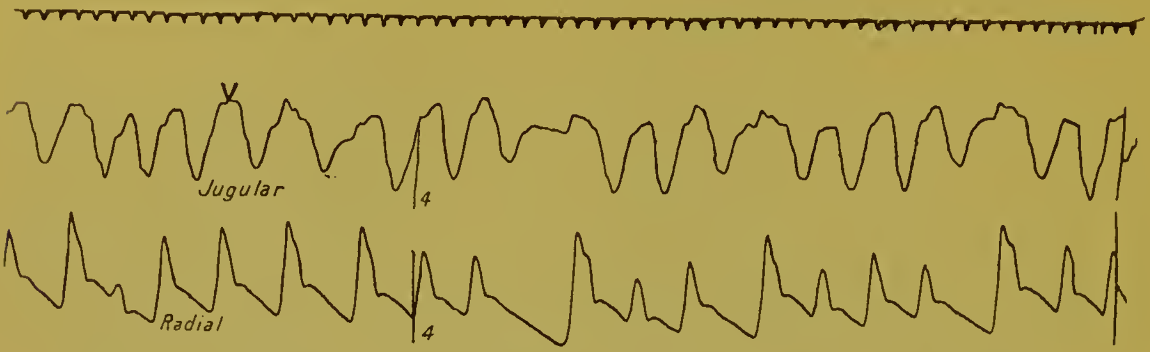

Fig. 15. Radial and jugular tracings from *CASE 7*, before digitalis. Rate 88.

Treatment and progress. The patient was treated by rest in bed for the first fortnight, and made some slight improvement, though he was still very breathless. He suffered at times from headaches which became very severe while he was under the influence of digitalis. On March the 5th he was put on tincture of digitalis, 15 minims four times a day. This was continued till the 13th, when he had taken 9 drachms. The pulse rate became slow, falling to 66 beats on the 9th (Fig. 16). There was a distressing sensation of throbbing of the heart but the dropsy had disappeared, the liver was much reduced and the veins of the neck less distended. On account of the severe

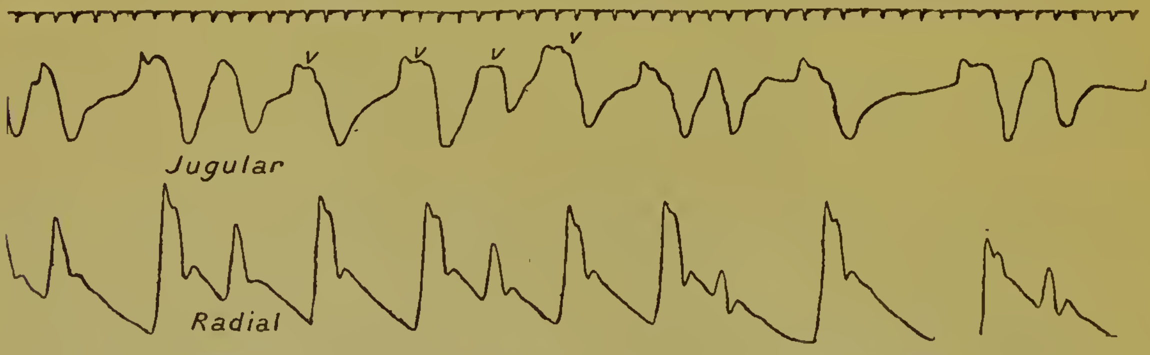

Fig. 16. Tracing of jugular and radial from *CASE 7*, after digitalis. Rate 66.

headaches the digitalis was stopped on the 13th. The effects of the digitalis passed off in a few days, his breathing became distressed and the pulsation and swelling of the jugular vein increased and the heart's rate quickened. On April the 1st he was very ill and was put upon tincture of strophanthus, 30 minims four times a day, and this was continued for three days. His heart's condition rapidly improved, but he felt ill with headache, vomiting and diarrhœa. Gradually the disagreeable symptoms disappeared and for a time he felt better, but as the effects of the strophanthus passed off, his heart again gave way. We endeavoured to find a remedy which would improve his heart's condition without any disagreeable accompaniment, but whenever an effective quantity of digitalis was taken he suffered from severe headache, and when an effective quantity of strophanthus was taken he suffered in addition from diarrhœa. We tried tincture of squills, but it acted like the digitalis in benefiting the heart but inducing severe headache. As he always relapsed when digitalis, strophanthus and squills were stopped, we kept him on digitalis intermittently and in smaller doses, and he seemed at last to acquire a tolerance for the digitalis. From December the 16th till his discharge on January the 13th, 1911, he was kept under the influence of digitalis, taking as a rule 30 minims of the tincture in the day, and stopping it for a day if nauseated. He kept very well under this treatment, though the heart beat generally 70 or 90 times to the minute; he was able to walk about in comfort, and was fit for work of a light description (see Chart, Fig. 17).

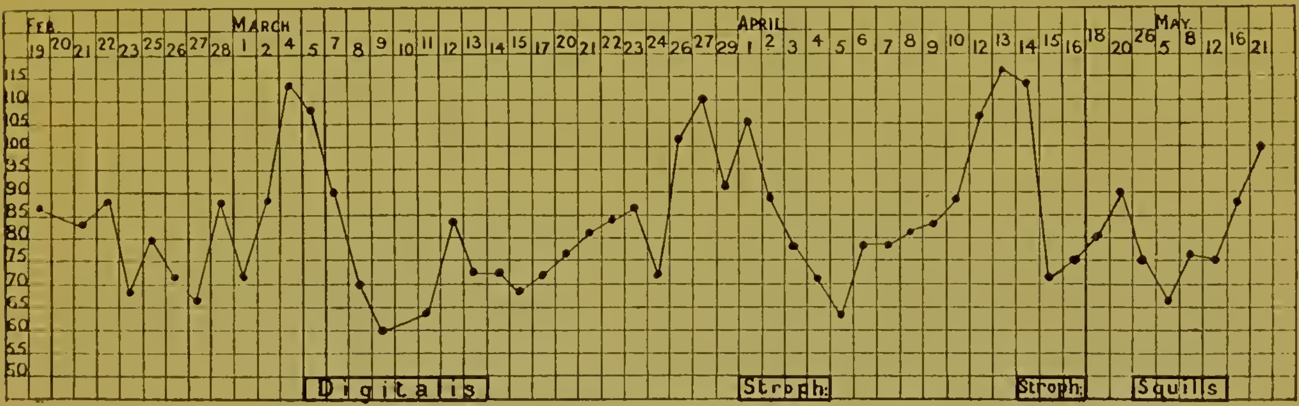

Fig. 17 Chart of *CASE 7.*

DATE.	DRUG.	PULSE RATE.	URINE.	SIZE.	REMARKS.
Feb.					
19		87	37		Short of breath, no pain, must sit up.
20			43		
21		84	54	1½-7½	Little better, lies down easily on two pillows.
22		88	62		Severe headache, very thirsty, slept fairly.
23		67	75	1-6½	Headache less.
25		80	55	1-6¼	Still headache.
26		72	60	1¼-6¼	Feels better, headache better, slept better.
27		66	78		
28		88	71	1¼-5½	Feels better.

DATE.	DRUG.	PULSE RATE.	URINE.	SIZE.	REMARKS.
March.					
1		72	70	1½-5½	Feels better, headache much better.
2		88	72	1-6	Continued improvement, no pain.
4		114	48		
5	Digit. ʒi p.d.	108	74		
7		90	51		
8		70	45		Feels fairly well.
9		60	65		Feels fairly well.
10			65		Not so well, much throbbing in neck.
11		64	52	1¼-5½	Better, less throbbing, had to sit up two or three times in night on account of throbbing and shortness of breath.
12		84	43		
13	ʒix Digit stopped	72	75		Headache, appetite good.
14		72	40	1¼-5¾	No headache, no appetite.
15		68	62		Feels well, slight appetite.
17		72		1¼-6	Feels better, appetite returned.
20		76	44	1½-5½	Feels fairly well, appetite good.
21		81	36		
22		84	37	1½-6	Not so well, pain fluttering in left breast, some dyspnœa.
23		86	49		
24		72	54	1½-5½	Feels better, easier, less dyspnœa.
26		102	61		
27		110	45		
29		92	29		
April.					
1	Stroph. ʒii p.d.	105	37	1½-6	Feeling very ill and breathless, heart fluttering and thumping.
2		88	36		
3	ʒvi Stroph. stopped	78	36		Feels better but severe headache at back of head which keeps him awake.
4		71	30	1-5½	Feels very seedy, headache, vomiting and diarrhœa.
5		64	39	1¼-5¾	Feels better, still a little headache.
6		84	40		Feels better, very little headache.
7		84	68		Feels better, no headache, appetite good, diarrhœa stopped.
8		86		1-5½	Feels better, appetite good.
9		87	46		Fairly well, sleeps better.
10		94	46		
12		106	34	1-6	Breathing easy, heart beating fast and fluttering a lot, slept poorly.
13		116	42		Breathing easy, heart fluttering a lot, slept badly.
14	Stroph. ʒi p.d.	114	32		
15		71	42		Heart seems quieter, breathing easier. beating in neck less troublesome. Diarrhœa.
16	ʒiv Stroph. stopped	75	48		
17			32		Diarrhœa bad.
18		80	42	1¼-5½	Headache bad, heart feels quite quiet, diarrhœa still persists. Slight abdominal pain.
19			42		Diarrhœa ceased.
20		90	38		
23					
26	Squills, ʒi p.d.	75	48		Feels ill.
May.					
5		66	76	1¼-5¼	
8		76	66		Feels well, sleeps well, appetite better. Very short of breath after exercise.
12	ʒxix Squills stopped	75	56	1¼-5½	Headache severe, heart steadier.
16		88	56	1¼-6	Feels fairly well, but for headache which is very troublesome, fairly good after exercise.
21		100	49	1-6	Heart thumping a lot. Sleeps badly. Frontal headache still severe.

Date	Drug.	Pulse Rate.	Remarks.
Dec. 1910.			
11	Digit. ʒi p.d.		Breathing distressed on slight exertion.
12		80	Breathing less distressed.
13		64	Breathing easier.
14	30 minims. p.d.	68	Much improved.
15		70	
16		80	Breathing not so good as yesterday.
17		74	Breathing little easier.
19		80	
20		90	Breathing same.
21		64	Vomited this morning, headache.
22	30 minims p.d.	72	No further vomiting, headache improved.
28		88	Feels well.
29		90	Feels well.
30		90	Slept badly, throbbing in neck, palpitation, some dyspnœa, had to be propped up with pillows.
31		76	Slept well, feels better.
Jan.			
2		74	Feels well, can walk about and go up flight of stairs without distress.
3		90	Same.
4		80	Same.
5		88	
6		90	Feels well.
7		88	Slept better.
9		84	Feels well able to walk about and go up stairs without distress.
10		78	Same.

CASE 8, male, aged 22 years. Auricular fibrillation. Mitral stenosis. History of chorea. Increased flow of urine, vomiting and decrease in pulse rate after digitalis. Aconitine had no effect on the heart.

Admitted August the 19th, 1910, complaining of weakness and shortness of breath and loss of power of left leg and arm.

History. He had had chorea at six and eight years of age, but there was no history of rheumatism. He had typhoid fever in 1897. For some years he had suffered from shortness of breath and palpitation on exertion, but was able to follow his occupation as a barman. In June, 1910, he suddenly lost consciousness and when he recovered he was unable to move his left arm or left leg. Since this time he had lain in hospitals and was admitted into Mount Vernon Hospital from another hospital.

State on admission. The patient lay flat in bed in comfort. He could move his left arm and leg with difficulty and to a slight extent. He was very short of breath on the slightest exertion. The pulse was 100 per minute and continuously irregular. The heart's dulness lay $1\frac{5}{8}$ and $5\frac{1}{8}$ inches to right and left of the mid-sternal line. At the apex there was a systolic and a diastolic murmur. There was no dropsy.

Treatment and progress. From August the 19th to the 23rd the patient received no treatment and the pulse varied from 100 to 110 per minute.

On the 23rd he was put on aconitine, and though it was carefully pushed it had no effect upon the pulse rate, except at times when it seemed to quicken it. From August the 23rd to September the 6th (when the aconitine was stopped), the pulse rate varied from 84 to 156 beats per minute. After all signs of aconitine effect had gone, he was put on tincture of digitalis, 15 minims four times a day on September the 9th. This was continued till September the 15th when it was reduced to twice a day, as on this and the previous day he had been nauseated and had had headache and vomiting. The drug was stopped on the 16th as the vomiting persisted. The following day he felt much better and could breathe with greater comfort after exertion, and continued in this improved condition till his discharge on September the 21st (see Chart, Fig. 18).

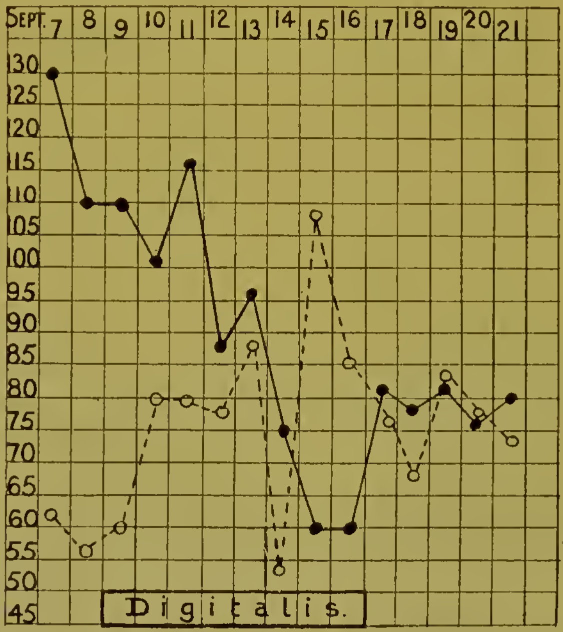

Fig. 18. Chart of *CASE 8.*

The solid line represents the pulse rate and the interrupted line the urine in ounces.

DATE.	DRUG.	PULSE RATE.	URINE.	REMARKS.
Sept.				
7		130	61	
8		110	56	
9	Tr. Digit.	110	60	
10	ʒi p.d.	102	80	
11		116	80	
12		88	78	
13		96	88	
14		75	54	Feels much better.
15	30 minims.	60	108	Nausea.
16	Digit. stopped.	60	85	Nausea, headache, vomited.
17		82	76	No vomiting, feels much better.
18		78	64	
19		82	83	
20		76	77	
21		80	74	Feels very well.

CASE 9, female, aged 35. Auricular fibrillation. Mitral stenosis. Digitalis produced vomiting, headache and marked slowing of the pulse rate; followed by marked improvement in the general condition. Aconite, strophanthus and squills were also given.

Admitted July the 26th, 1910, complaining of shortness of breath and throbbing of the heart.

History. The patient suffered from "bronchitis" at 25 and had palpitation off and on until admission, she was worse during the two years preceding admission. She had a severe attack of breathlessness four years before admission; there was no history of rheumatism.

State on admission. The patient was very ill and lay propped up in bed. The breathing was rapid and laboured and was aggravated by the slightest movement. The pulse was rapid and irregular, 125 beats per minute. The heart's dulness lay 1 and 5¼ inches to right and left of the mid-sternal line. At the apex the sounds were clear but the second was followed by a murmur which filled up the whole diastolic period when the heart was rapid, but when a pause occurred there was a clear interval between the diastolic murmur and the first sound. The liver was three fingers' breadth below the costal margin.

Treatment and progress. The patient being in great distress she was at once put on tincture of digitalis, 15 minims three time a day, and this was continued till the 31st when she had taken 4 drachms; it was stopped as it caused nausea and headache. The patient's breathing was greatly relieved and the pulse rate fell to 61 beats per minute. After stopping the digitalis the disagreeable sensations passed off and the increased liver dulness was almost gone. The pulse rate slightly increased. She was kept at rest in bed till August the 17th and improved considerably. She was then given aconitine which was carefully pushed for 10 days but with no beneficial effect. On September the 2nd she was again given digitalis but was taken ill with some obscure abdominal complaint and it was not continued. In a couple of days she was better and the digitalis was resumed on the 14th, 15 minims were given four times a day. On the 17th she was sick and vomited and the drug was stopped after she had taken 4 drachms. The pulse rate fell to 62-56 beats per minute. After this date the sickness soon subsided and the patient felt better, but the pulse rate increased in frequency and on September the 24th she was given tincture of digitalis, 10 minims three times a day, for five days. This brought on severe headache and nausea with slowing of the pulse to 52, and the drug was then stopped and the pulse rate gradually increased. The patient's pulse rate varied and for some days was between 120 and 130. On October the 16th she was put on tincture of squills, 20 minims four times daily, which was increased on November the 2nd to 30 minims four times daily. While taking this she suffered a good deal from headache, and though the pulse was not markedly slowed she felt better than she did when taking the digitalis. In November the headache became less severe but on the 14th she suffered from diarrhœa which persisted for four days. This subsided but returned with retching; the drug was stopped on November the 21st. After a few days, the pulse rate increased, varying from 94-120, and on November the 29th she was put on tincture of strophanthus, 20 minims three times daily, but after six doses (2 drachms) the heart slowed to 54, she vomited and had some diarrhœa, and the drug was stopped. After this the pulse rate again increased to 100, and she was put on tincture of digitalis, 15 minims thrice daily on December the 10th. The pulse slowed and the dose was reduced on the 14th to 10 minims. On the 17th she had some headache and was nauseated and the drug was stopped for one day and resumed in 10 minim doses. With this amount she kept fairly well. The drug was occasionally stopped and resumed again until her discharge on January the 11th; at this time she was fairly comfortable when not exerting herself much and was able to go about quietly.

DATE.	DRUG.	PULSE RATE.	URINE.	SIZE.	REMARKS.
July.					
26		125		1-5½	Breathing very distressed.
27	Tr. Digit.	106	23		
28	45 minims p.d.	90	30		
29		96	41		
30		80	24½		Severe headache and nausea.
31	ʒiv Digit.	64	31		Severe headache and nausea.
Aug.	stopped				
1		85	37		Severe headache and nausea.
2		60	30		Severe headache and nausea.
3		74	45		Headache gone.
4		90	44		
5		72	36		Feels better, still short of breath.
Sept.					
11		68	35		
12		72	36		
13		68	33		Breathless and palpitation on slightest exertion.
14	Tr. Digit.	78	25		
15	ʒi p.d.	68	26		
16		74	40		Nausea and severe headache.
17	ʒiv Digit.	64	12		Vomited.
18	stopped	56			Vomiting.
19		52	12		Feels better, breathing easier on exertion.
20		54	12		
21		69	20		
22		60	30		
23		76	40		Still very short of breath on exertion.
24	Tr. Digit.	87	34		
25	30 minims p.d.	80	20		
26		68	15		
27		67	24		Headache and nausea.
28		60	20		
29	ʒii Digit.	52	42		Severe headache and nausea.
30	stopped	60	20		Headache, slight nausea.
Oct.					
1		75	24		Headache better, no nausea.
3		74	22		
6		116	40		
10		120	20		

Date.	Drug.	Pulse. Rate.	Urine.	Size.	Remarks.
Oct.					
11		130	32		
12		127	20		
14		96	20		
15		80	20		
16	Tr. Scillæ	80	44		
17	80 minims p.d.	80	40		
22		90	20		
27		80	22		
Nov.					
1	Tr. Scillæ	81	23		Slight headache.
4	ʒii p.d.	84	20		
7		70	22		Feels fairly well and can walk about with less distress.
10		88	20		
14		80	40		Diarrhœa.
17		78			Bowels moved five times, feels much better. Bowels moved twice.
18		62	30		Headache, still breathless on slight exertion.
19		60	24		Still headache, pain below left breast.
21	Scillæ stopped	76	20		Retching in night, and this morning, occipital headache.
22		66	16		Retched a little in night, better this morning. Diarrhœa.
23		72	24		No headache, no pain. Diarrhœa.
24		100	34		Feels well.
25		104	24		Cough makes heart beat rapidly.
26		120	10		Cough still troublesome.
28		94	20		Feels better, cough better.
29	Tr. Stroph. ʒi p.d.	110	30		Heart beating quickly at night for 1½ hours. Cough still troublesome.
30		74	10		Cough little easier. Heart beating quickly and jumping in night. Kept her awake.
Dec.					
1	Stroph. stopped ʒii	54	20		Vomited three times this morning. Headache. Diarrhœa. Breathing easier but feels ill.
2		56	30	1½-5	Still feels much nausea, no vomiting. Headache. Diarrhœa.
3		74	22		Nausea gone, has headache, diarrhœa.
4		96	19		
4		84	22		Feels better, diarrhœa ceased, "heart quickens at least thing," especially in night.
6		104	20		Feels the same.
7		100	24		Had an aching pain like "toothache" in precordium from 1 to 3 a.m. No sleep. Brought up a few clots of blood last night.
8		104	16		
9		104	24		Breathing short, palpitation in night.
10	Tr. Digit.	92	20		Slept badly.
11	45 minims p.d.		40		
12		86	26		
13		82	20		Very little sleep, slight nausea, headache.
14		62	24		Slept well, feels better, nausea, headache.
15		64	24		Slept very well, has headache, throbbing, slight nausea.
16		64	24		Slept well, still headache, nausea.
17		60	20		Headache severe, feels sick, no vomiting.
18		78	20		Feeling very sick, retching off and on during night, headache.
19	Tr. Digit.	62	16		Feels well, no further retching.
20	30 minims p.d.	64	20	1-6	Slight headache, breathing short on exertion.
21		72	28		Felt faint, headache.
22		70	24		Feels fairly well.
23		68	20		Feels fairly well.

CASE 10, female, aged 44. Auricular fibrillation. Mitral and aortic regurgitation. Digitalis and strophanthus decreased the pulse rate and caused vomiting and headache, followed by marked improvement.

Admitted February the 2nd, 1910, complaining of shortness of breath, palpitation and cough.

History. There was no history of rheumatic fever but at the age of 18-19 she suffered much from pain in her knees, but was able to keep at work. Five years before admission she began to be short of breath and two years before admission she became conscious at times of her heart beating violently and irregularly. Occasionally during the two years previous to admission her legs had swollen. She was married and had had two children.

State on admission. The patient lay propped up in bed, very short of breath on the slightest exertion. Face and lips dusky. There was some oedema of the legs. There were moist crepitations at the bases of the lungs. The respirations were 30 per minute. The pulse was anacrotic and continuously irregular ; the rate 98 per minute. The apex beat was in the 5th interspace outside the nipple line. The heart's dulness lay 1 and 5½ inches to right and left of the mid-sternal line. At the apex there was a soft systolic murmur and a soft murmur after the second sound. The murmur was at first low pitched, and at times not perceptible ; as she improved, the mitral murmur became permanent, and there were in addition systolic and diastolic aortic murmurs. The liver was slightly enlarged. There was a slight trace of albumen in the urine.

Treatment and progress. The patient was treated for five days with complete rest in bed and so far improved as to be able to lie in bed with comfort, the oedema of the lungs and legs and the enlargement of the liver disappeared. The pulse rate, however, continued to be rapid and she was put on tincture of digitalis, 15 minims four times a day on February the 7th ; this was continued till the 11th when she had taken 3¾ drachms. She vomited on the 10th and 11th and the pulse rate fell. By the 14th vomiting had passed off and she felt much better and continued to feel better while the pulse rate kept slow. Gradually she was able to walk about with much less distress. On March the 1st she was put on tincture of strophanthus, 15 minims four times a day, and this was continued till the 31st when the dose was increased to 30 minims four times a day. No discomfort was experienced while she was taking the smaller dose, but on April the 6th she was sick and vomited, and the drug was stopped after she had taken in all 40½ drachms in 37 days. The pulse rate was practically unaffected till April the 4th when it fell considerably in rate. After the nausea passed off, the patient felt much better and continued fairly well till she was discharged on April the 22nd, 1910 (see Chart, Fig. 19).

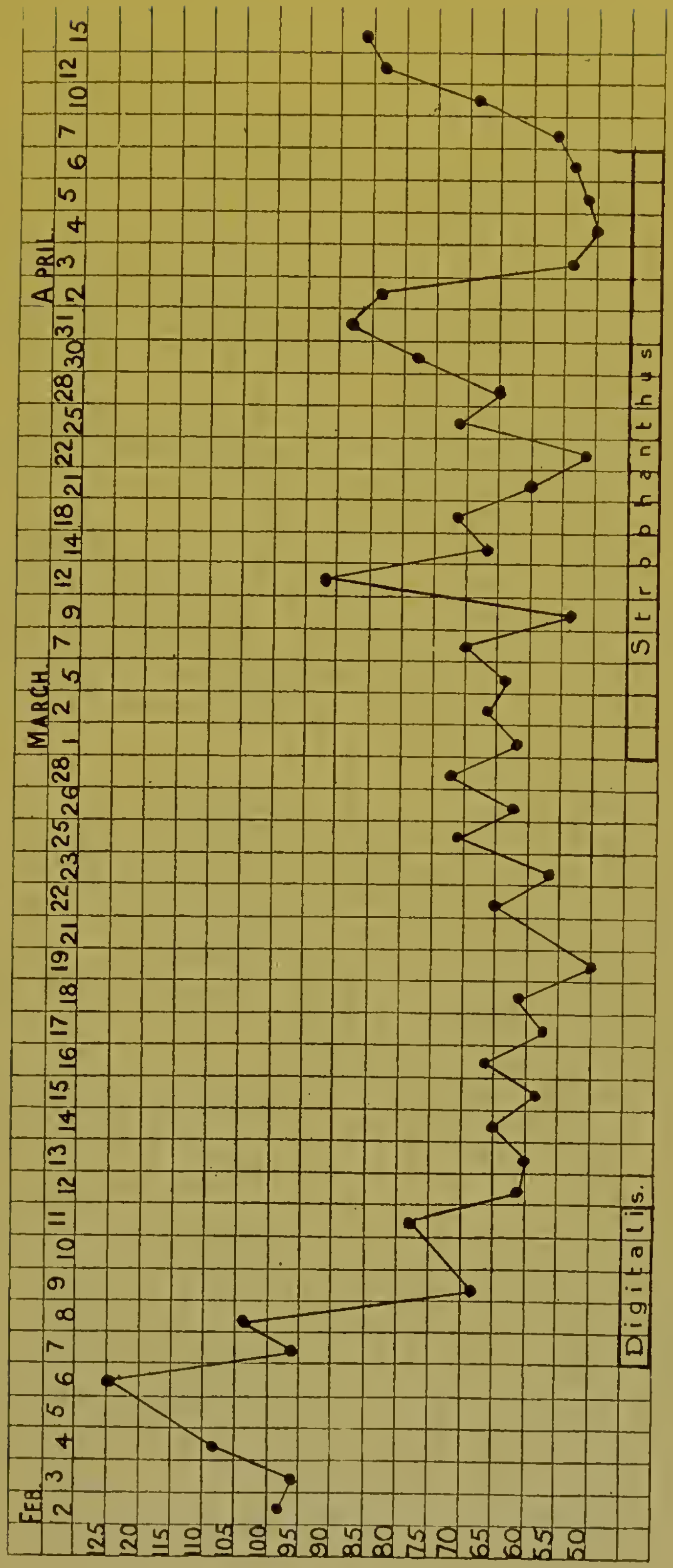

Fig. 19. Chart of *CASE 10.*

DATE.	DRUG.	PULSE RATE.	RESP.	SIZE.	URINE.	REMARKS.
Feb.						
2		98		½-4½	44	Cough, breathless, palpitation, has to be propped up.
3		96	30		10	
4		108	32		8	Slight cough, dyspnœa, palpitation, sleepless.
5					15	
6		125			25½	
7	Tr. Digit. ʒi p.d.	96	38	1-5½	28	Much more comfortable, can lie with few pillows.
8		104	32		20½	
9		69	32		24	Dyspnœa less.
10						Feeling ill, vomited, no appetite, headache bad.
11	ʒ iii Digit.	78	45	1-4½	21	Ill, vomiting.
12	stopped	61	34		14	Vomited last night, resting comfortably head only on pillows now.
13		60			8½	
14		65	37		15	More comfortable.
15		59	34	1-4¾	17	Better, breathing better.
16		66	34		11	Feels fairly well.
17		57	34		50	Better, much happier, no complaints.
18		61	26	1-5	17	
19		50	24		18	Feels well, breathing easy.
21					12	Feels well, breathing easy.
22		65	22		16	Feels well, breathing easy. Very distressed after going up flight of stairs.
23		56	36		20	
25		71			24	Feels better. Getting up.
26		63		1-5¼	14	Still better, headache.
28		72	24		33	Much better.
March.						
1	Tr. Stroph.	62	28		37	
2	ʒi p.d.	66	20		26	Feels well.
5		64	22		25	Feels well.
7		70			26	Dyspnœa after exercise.
9		54	18	¾-5	25	Can lie flat without dyspnœa, cannot sleep so.
12		92			15	Feels well.
14		66			23	Feels well.
18		72	16		18	Feels well.
21		60	24	1-5½	18	Feels well. Slight cough. No dyspnœa.
22		52	30		14	
25		72			18	
28		65			24	
30		78	20		20	Very well, but noticed ankles swollen after walking. Some dyspnœa after exercise and slight œdema of feet.
31		88	20		21	Very well.
April.						
2	Tr. Stroph.	84	20		27	Slight œdema of feet. Feels well.
4	ʒii p.d.	54	18		17	Feels well. Slight œdema of feet after exercise.
5		50	20	½-5	23	Feels well. Slight œdema of feet after exercise.
6	ʒxlss Stroph.	52			0	Felt sick all night, only retching.
7	stopped.	54			15	Still nausea, slight headache. Feels quite well.
8		56			20	
10		68			19	
12		84			22	
15		86			20	
20		92			22	Feels very well.

CASE 11, male, aged 27. Auricular fibrillation. Response to digitalis.

Admitted December the 17th, 1910, complaining of distressing palpitation on exertion.

History. The patient was in good and vigorous health up till June, when he received a blow over the heart in boxing. A few hours after he became conscious of an unpleasant fluttering over the heart. From that time he had been liable to attacks of palpitation, particularly after exertion, sometimes in quietly walking or on standing up. There was no history of rheumatism or of specific infection. He had lived a temperate life, though until a few months before admission he smoked heavily.

State on admission. The patient was tall, spare, muscular and healthy looking. The pulse rate was 85, the rhythm was continuously irregular, with the disorderly rhythm characteristic of auricular fibrillation (Fig. 20).

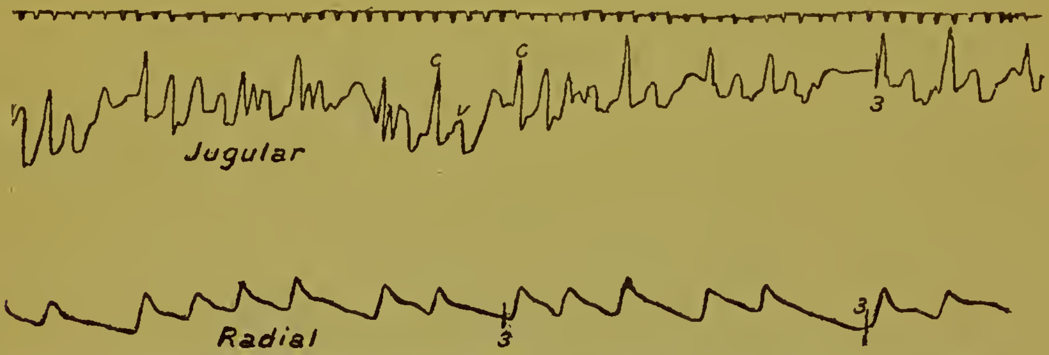

Fig. 20. Tracing of the jugular and radial pulses from *CASE 11*, before digitalis. The jugular pulse is characteristic of auricular fibrillation. The rate is 75 beats per minute.

The heart's impact was slight and was felt just below the nipple line. The heart's dulness lay ½ and 5 inches to right and left of mid-sternal line. The sounds were clear and free from murmurs, the second sound at the apex being slightly reduplicated. The internal jugular vein was full and pulsated. The pulsation was of the ventricular form and showed the characteristic fibrillation waves.

Treatment and progress. In view of the recent occurrence (June, 1910) of the auricular fibrillation, I felt it might be possible to restore the normal rhythm with complete rest. I had also seen one case revert to the normal rhythm under digitalis, so he was put to bed, and given one granule of Nativelle's digitalin three times a day. His pulse rate speedily fell to 48, and in a few days the heart's size was distinctly less, but there was no sign of a return to the normal rhythm. After nine granules he felt sick and nauseated on December the 22nd; the drug was stopped for three days when he was put on two granules a day which he continued to take till January the 16th. He was allowed to get up and go quietly about on January the 10th. He was carefully examined on January the 16th. He was feeling much better, was able to go about in comfort and was scarcely troubled with palpitation. The pulse was still irregular, 52 per minute (Fig. 21). His heart's dulness was reduced to 0 and 4 inches to right and left of the mid-sternal line. He was advised to take one granule per day.

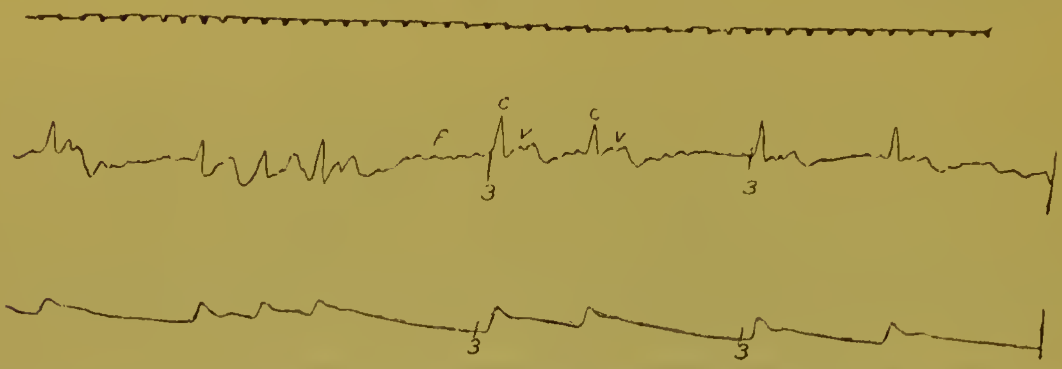

Fig. 21. Tracing of jugular and radial pulses from the same case as Fig. 20, when under the influence of digitalis. The jugular pulse shows well marked *f* waves due to the fibrillating auricle. Rate 52 beats per minute.

February the 23rd. He had been going about and was able to undertake a considerable amount of effort. He was taking one granule per day. The heart was in the same state as on January the 16th (see Chart, Fig. 22).

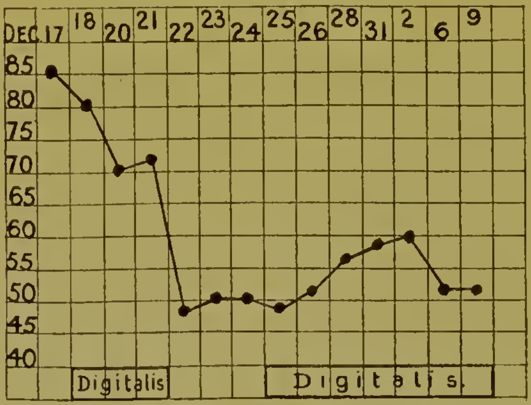

Fig. 22. Chart of *CASE 11.*

DATE.	DRUG.	PULSE RATE.	REMARKS.
Dec.			
17		85	
18	Digit. (3 granules)	80	
20	,,	70	
21	,,	72	
22	Digit. stopped	48	Nausea.
23		50	Nausea gone.
24		50	
25	Digit. (2 granules)	48	
26	,,	52	
28	,,	56	
31	,,	58	
Jan., 1911.			
2	,,	60	
6	,,	52	Coupled beats.
9	,,	52	

CASE 12, male, aged 53. Auricular fibrillation. Digitalis had a prompt effect in slowing the heart. Aphasic attack during digitalis.

Examined July the 27th, 1910, complaining of shortness of breath and inability to lie down.

History. He had always had a " weak heart ". He had been greatly worried during the few years prior to admission, and his heart had been known to be irregular for some years. For some months he had been short of breath, but lately he had felt very much worse and a few days previously to admission had been unable to lie down. He had been treated for some days with repeated injections of strychnine without relief.

State on admission. The patient was sitting up, with laboured breathing and in evident distress. He could not keep still long but had to move about in the endeavour to get relief from the sense of suffocation. The pulse was scarcely perceptible and was very rapid, a tracing was obtained with difficulty and the rate was found to be 160 per minute with occasional slowing for a few beats. The heart's dulness lay 2 inches beyond the nipple line and the sounds were clear and free from murmur.

Treatment and progress. Six granules of digitalin (Nativelle's) per day were prescribed, and after taking six the pulse had fallen to 108. After he had taken ten, the pulse had fallen to 92. The dose was then diminished. Four days after beginning the digitalis he had an aphasic attack during which he could not use nouns. This passed off in a few days. From this date the patient's condition gradually improved. I saw him on October the 22nd. He was taking one granule of digitalin per day and his doctor told me that this dose kept his pulse at a moderate rate. His pulse was continuously irregular, from 76 to 80 beats per minute, and tracings of the jugular showed the characteristic ventricular form of venous pulse with fibrillation waves. He could get about and attend to his business and felt comfortable and well, though moderate exertion caused a good deal of breathlessness.

CASE 13, male, aged 23. Auricular fibrillation. Aortic and mitral disease. Slight fever. Digitalis and strophanthus had little or no effect on the heart.

Carman, admitted April the 11th, 1910, complaining of shortness of breath and palpitation on exertion.

History. The patient had had rheumatic fever at 15 and 21. The last attack of rheumatic fever was in December, 1909, and for this he was kept in bed for 28 weeks, and had not been able to do any work afterwards because of weakness and shortness of breath.

State on admission. The patient, when lying in bed was free from distress; he looked pale but otherwise healthy. The pulse was large, full and collapsing, continuously irregular and beating at about 80 beats per minute. There was marked pulsation of the carotid. The apex was large, diffuse and forcible in the 5th interspace. The heart's dulness lay 1 and 6 inches to right and left of the mid-sternal line. At the apex a rough systolic and a blowing diastolic murmur were heard. In the aortic area, a soft systolic and a diastolic murmur were audible. The systolic murmur was heard over the carotid. The liver was enlarged and pulsated, the border was felt at the level of the umbilicus. There was also some pulsation in the jugulars, and both jugular and liver pulses were of the ventricular form.

Treatment and progress. The patient was kept at rest for a fortnight with little change in his condition. On April the 27th he was put upon tincture of digitalis, 15 minims four times daily. This was continued till May the 9th, when he had taken 12 drachms of the tincture. This had only a slight effect, the pulse slowing down to 72, and causing slight nausea and stomach-ache. The liver was not so large, reaching two fingers below the ribs. He was still very breathless on exertion. On May the 14th he was put on tincture of strophanthus, 30 minims four times a day. This was continued till May the 24th, when he had taken 19 drachms. He vomited on that date and there was slight slowing of the heart's rate, but the liver enlargement, to two fingers breadth below the ribs, persisted. On May the 27th the tincture of strophanthus was resumed, in doses of 30 minims four times a day and continued till June the 1st, when it was intermitted for one day, and then resumed in doses of 30 minims twice daily and continued till June the 15th. From May the 14th till June the 15th he had taken 40 drachms altogether, and though he fancied he felt somewhat better, yet no definite evidence of improvement could be detected. The pulse rate not slowing, and the liver was of the same size and the respiration was laboured and rapid after exertion.

During the whole time of his stay there was a tendency for the temperature to rise above normal, and on June the 6th, he developed a mild attack of rheumatic fever which persisted till the 15th. On that date he was put on salicylate of sodium and the temperature fell while he had the salicylate which was stopped on the 23rd. At his request the patient was discharged, little if any better. He died from heart failure two months after his discharge from the hospital.

DATE.	DRUG.	PULSE RATE.	TEMP.	SIZE.	URINE.	REMARKS.
April.						
12		81	97·6	1-6	25	Short of breath and palpitation on exertion.
14		80	98·6		35	
16		86	98		20	
18		74	97·6		22	
20		80	97		32	
24		74	98·6		44	
26		96	98·8	1½-5¾	40	Occipital headache. No palpitation.

DATE.	DRUG.	PULSE RATE.	TEMP.	SIZE.	URINE.	REMARKS.
April						
27	Tinct. Digit.	88			32	
28		96			43	
29		88	97		63	Feels better, still short of breath.
30		90	98		58	
May.						
2		76	98·8		60	Feels rather better.
4		74	97·6		56	
6		64	97·4		49	
7		66	98·4		47	
8		72	98·8		47	Feels very well when quiet. Sleeps well, appetite good.
9	ʒxii Digit. stopped	90	97·6	1½-5½	40	Nausea and stomachache. Temporal headache.
10		76	99		38	
11			99·6		35	
13		80	99		32	
14	Tinct. Stroph.	74	97·6	1¼-6	44	Severe stabbing pain in chest. No sleep last night.
16			98·4		46	Pain bad last night, much better now, worse when lying down.
18		73	98·3	2-5½	35	No pain in chest, breathing easier.
20		70			27	
22		66			48	
24	ʒxix Stroph.	64	97·2		28	Vomiting to day.
25	stopped	66	98		30	
27	Tinct. Stroph.	78	98·4		39	
28		76	98		37	
29		72	99·6		42	
30		78	98·6		43	Feels better, had better night, still some pain in left chest. Very short of breath.
31		84			53	
June.						
1	ʒix Stroph.	80	97·8		48	Nausea, short of breath.
2	stopped	76	97·2		58	Feeling very well, no pain at all. Very short of breath on exertion.
3	Tinct. Stroph.	88	98·4		33	
5		80	97		47	Feels well, no pain, breathing easier.
6		84			53	
9		74	98·6		38	
10		80	98		30	
12		96	98·4		75	
13		84	99	1¼-6¼	46	
14		78	99·4		50	
15	ʒxii Stroph. stopped	84	97		44	Pain in joints since last night, both knees and left wrist swollen and tender.
16	Sod. Sal.	80	97·6		68	Much better, pain all gone from joints though they are still very stiff. Buzzing in ears.
17		63	97·6	1½-6½	21	
18		76	97		32	Feeling very well, still a buzzing in ears.
19		66	98·2		28	
20		76	98		28	
21		80	98		34	
23	Stopped.	96	99		26	No deafness for the last two days. Feeling ill and sick to-day.
24		108	98	2-7	20	Not feeling very well to-day, heart thumps a lot, shaking him about.

CASE 14, male, aged 42. *Auricular fibrillation. Mitral disease. Rheumatic history. Slight response to digitalis.*

Waterside labourer, (irregular heavy work with much exposure), admitted to the London Hospital, January the 19th, 1911, complaining of shortness of breath and palpitation on exertion.

History. The patient had had rheumatic fever twenty-four years before. In June, 1909 he attended the out-patient department for a pain in his right shoulder, and was then found to have mitral incompetence. The pulse was regular at the time of his discharge in January, 1910. In February, 1910 he fell overboard and was nearly drowned, and the next day he was distressed with palpitation and shortness of breath. He was admitted as an indoor patient on March the 2nd, when his pulse was very irregular. He was discharged to out-patients on March the 16th, his pulse remaining irregular. He had been in attendance as an out patient till his re-admission on January the 19th, 1911. He had been unable to work, being very short of breath and easily upset by excitement.

State on admission. The patient lay comfortably in bed, and was free from distress while quiet. He looked healthy. The pulse was continuously irregular, 70 beats per minute. The heart's dulness lay ½ and 5 inches to right and left of the mid-sternal line. There was a systolic mitral murmur, and a reduplicated second sound. He was breathless on the slightest exertion, such as going up a flight of stairs.

Treatment and progress. He was kept at rest in bed for four days and on January the 24th he was put on tincture of digitalis, 20 minims three times daily, and this was continued till January the 30th, when he vomited. He had taken 5 drachms and 40 minims. There was no effect on the pulse rate, except on the day upon which he vomited, when it fell to 52 beats per minute. There was little change in his condition though he could undertake effort with less distress. After ten days the patient was put on tincture of digitalis, 30 minims per day, and kept on this almost continuously till April the 3rd, when he was greatly improved and able to do light work (see Chart, Fig. 23).

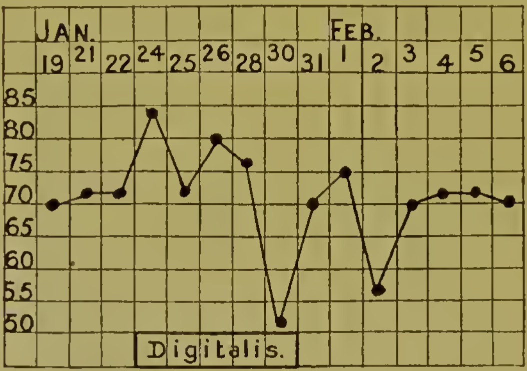

Fig. 23. Chart of *CASE 14.*

DATE.	DRUG.	PULSE RATE.	URINE.	REMARKS.
Jan.				
19		70	20	Comfortable, slight throbbing in precordial region at times.
20			22	
21		72	32	
22		72	52	

Date	Drug.	Pulse Rate.	Urine.	Remarks.
Jan.				
23			60	
24	Tinct. Digit.	84	60	
25	ʒi p.d.	72	32	
26		80	66	Quite comfortable.
27			44	
28		76	46	Slight pain and throbbing at apex.
29			32	Headache.
30	ʒv Digit.	52	30	Vomited three times.
31	stopped	70	14	Vomited.
Feb.				
1		75	46	Some headache, sleeps very well.
2		56	46	Feels well.
3		70	40	Feels well.
4		72	56	Headache.
5		72	48	Feels well.
6		70		Can undertake effort with less distress.

CASE 15, male, aged 67. *Auricular fibrillation. Senile. Digitalis had only a slight and transient effect on the heart rate.*

Admitted October the 13th, 1910, complaining of pains over left chest and shortness of breath.

History. On the whole he had always enjoyed good health. He had had small-pox at 30 years of age and gout at 37 years. Thirteen years before admission he noticed that pain in the chest and shortness of breath came on with exertion and these symptoms continued more or less until admission. He had also suffered from severe attacks of pain in the chest, characteristic of angina pectoris, but there had been no recent attack of pain though he had been very short of breath on exertion. He sometimes had a fluttering feeling over the heart.

State on admission. The patient was a stout ruddy faced man; he lay in bed without distress. The pulse was continuously irregular, 76 per minute, with the disorderly rhythm characteristic of auricular fibrillation. The chest was emphysematous, and it was impossible to percuss the heart limits with accuracy. The sounds were clear and free from murmurs.

Treatment and progress. The patient was kept at rest in bed, and during the first few days he was conscious of attacks during which there was a fluttering sensation over the heart. They were not observed by us and no notes were taken of the action of the heart during attacks. They gradually subsided and the patient improved in strength. He was put on tincture of digitalis, 20 minims thrice daily, on November the 23rd, and this was continued till the 30th when he had taken 7 drachms. It produced nausea and headache and for one day the pulse rate fell slightly in rate. The day after the drug was stopped he felt well and was discharged from the hospital on December the 3rd decidedly better and less short of breath on exertion. The long rest was probably the chief agent in restoring his strength (see Chart, Fig. 24).

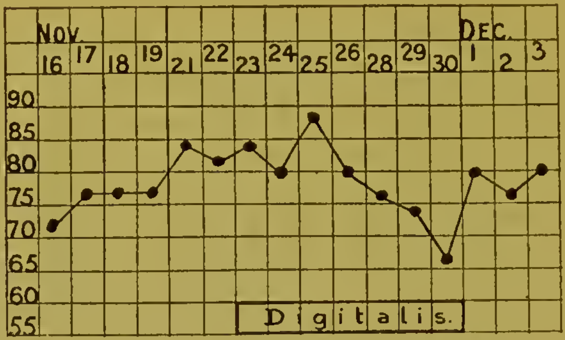

Fig. 24. Chart of *CASE 15.*

DATE.	DRUG.	PULSE RATE.	URINE.	REMARKS.
Nov.				
16		72	65	
17		76	69	
18		76	48	Feels well except for gouty toes.
19		76	67	Pain easier.
21		84	83	Feels well, short of breath on exertion.
22		82	82	Feels well.
23	Tinct. Digit.	84	71	Feels well, appetite good.
24		80	72	Feels well.
25		88	83	Feels well, no headache, appetite good.
26		80	70	Same.
28		76	84	Same.
29		74	76	Feels well, slight headache last night, better this morning.
30	ʒvii Digit. stopped	66	76	Much retching and nausea. Throbbing frontal headache.
Dec.				
1		80	95	Feels well this morning, no headache.
2		76	80	
3		80	80	Feels very well, less short of breath.

CASE 16, female, aged 32. *Auricular fibrillation. Mitral stenosis. Rheumatic history. Response to digitalis.*

Admitted January the 18th, 1911, complaining of great weakness and shortness of breath.

History. The patient had had rheumatic fever at the age of 16. She had been in hospital for heart trouble two, three, and five years before. Ten weeks before admission she became ill with shortness of breath, and her legs began to swell. She had been in bed twelve days before she came under my care. She was married and had five children.

State on admission. The patient lay propped up in bed, the breathing was laboured. The face was dusky. There was some ascites and the legs were slightly swollen. The pulse rate was rapid and continuously irregular, 90 beats per minute. The heart's dulness lay 0 and 5 inches to the right and left of the mid-sternal line. The apex beat was in the sixth interspace. There was a systolic murmur at the apex, and another murmur following the second sound and decreasing in intensity. When the heart was rapid, the latter murmur filled the whole interval between the second and first sounds. When the heart was slow, the murmur fell short of the first sound. (This was very evident when the rate decreased under the influence of digitalis.)

Treatment and progress. As the patient had been on small doses of digitalis and strychnine before coming under my care, she was not given any medicine for four days. Her condition did not alter during this time. On January the 22nd she was put on tincture of digitalis, 10 minims every four hours. She showed no improvement until the 25th, when she became much easier and the pulse rate fell. She vomited on the 27th, and the digitalis was stopped after she had taken 5 drachms. From this date she improved greatly and was able to lie lower in bed, on February the 3rd she could lie flat (see Chart, Fig. 25).

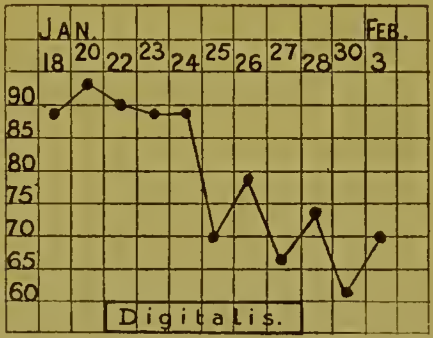

Fig. 25. Chart of *CASE 16.*

Date.	Drug.	Pulse Rate.	Remarks.
Jan.			
18		89	Lies propped up.
20		94	Cough, breathless. Orthopnœa.
22	Tinct. Digit.	90	Sudden attack of prostration last night, almost pulseless.
23		88	Breathing very distressed and laboured.
24		88	
25		70	Much easier and lies lower.
26		78	
27	ʒv Digit.	66	Two attacks of vomiting.
28	stopped	74	Comfortable.
30		62	Quite comfortable. Ascites and dropsy gone.
Feb.			
3		70	Comfortable, can lie flat.

CASE 17, female, aged 21. *Normal rhythm. Mitral stenosis. Digitalis given on three occasions, on the first it produced vomiting; on the second occasion it was followed by auricular fibrillation for four days, and on the third occasion heart-block occurred.*

Admitted October the 5th, 1910, complaining of palpitation, shortness of breath and pain in left side.

History. She had always suffered from shortness of breath and cough. These symptoms had become worse during the year preceding admission, and during the last three or four months she had had attacks of difficult breathing during the night. Palpitation was also readily induced on exertion. There was no history of rheumatism or chorea.

State on admission. The patient lay propped up in bed, the face was healthy looking and had a good colour. The pulse was regular, 96 per minute, (Fig. 26). The apex beat was in the 5th interspace, just outside the nipple line. There was a long thrill at the apex during the diastole of the heart. The heart's dulness lay $1\frac{1}{2}$ and 5 inches to right and left of the mid-sternal line. The first sound was sharp and clear; it was preceded by a long crescendo murmur. (When the heart became slower, a diastolic murmur was also heard at the apex.)

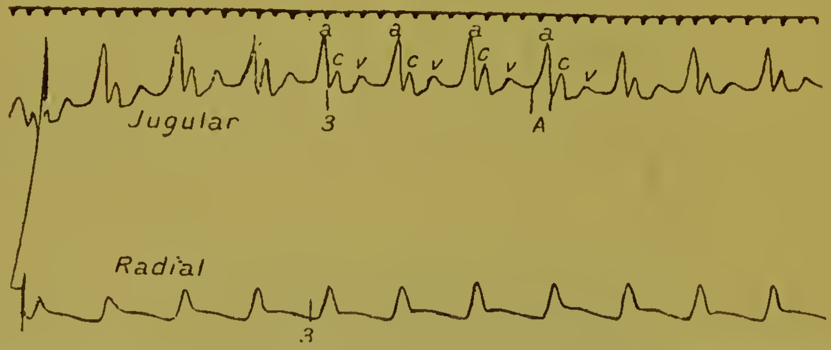

Fig. 26. Tracing of jugular and radial pulses, showing the normal rhythm before the administration of digitalis (*CASE 17*).

Treatment and progress. The patient was kept at rest for 13 days but did not make much improvement. On October the 18th she was given tincture of digitalis, 20 minims three times a day, and this was continued till the 25th when she had taken 7 drachms. While taking it she felt better until the 24th, when she vomited and suffered from headache. The vomiting ceased as soon as the digitalis was stopped and in a few days the headache was better but otherwise there was not much improvement. She continued to suffer from shortness of breath and palpitation on the slightest exertion and on November the 1st she was put on bromide of ammonium, 15 grains three times a day for a week, with no apparent benefit. She was again put on tincture of digitalis, 20 minims three times a day on November the 10th, and this was continued till the 17th when she had taken 7 drachms. She vomited and had headache and on this date a remarkable change took place in the heart's rate and rhythm. Hitherto it had been perfectly regular and rather rapid, sometimes over 100, but on the 17th it became irregular and slow, at a rate of 56 per minute. The presystolic murmur had gone and only a soft diastolic murmur was heard at the apex; and a silence preceded the first sound.

When the intervals between the heart beats were long this silence was very evident. This irregular action continued until the 20th (Fig. 27). On this date I visited the patient with Dr. Lewis and we both listened to the heart and commented on the irregularity and on the absence of a presystolic murmur. While we were examining her, the heart suddenly became perfectly regular and increased markedly in rate (110 beats per minute); on listening over the heart the presystolic murmur had returned. The tracings showed the differences in rate and rhythm and the reappearance of the auricular wave in the jugular pulse. After the sickness passed off, the patient felt much better and exertion did not cause much distress. On December the 9th, she was given digitalis, 20 minims thrice daily; this was continued till the 10th when she had taken 7 drachms. The pulse rate remained unaltered, but a marked sinus irregularity developed. This irregularity was still present on the 17th, and the interval between *a* and *c* sometimes varied, becoming greater during the period when the heart's rate increased; sometimes a ventricular beat dropped out (see Fig. 28). (See Chart, Fig. 29).

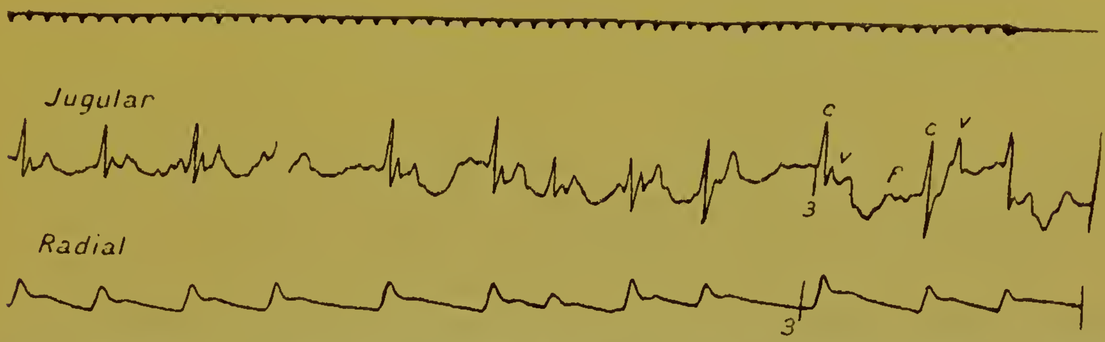

Fig. 27. Tracing of the jugular and auricular pulses during the period of auricular fibrillation induced by digitalis. Note the fibrillation waves *f* (*CASE 17*).

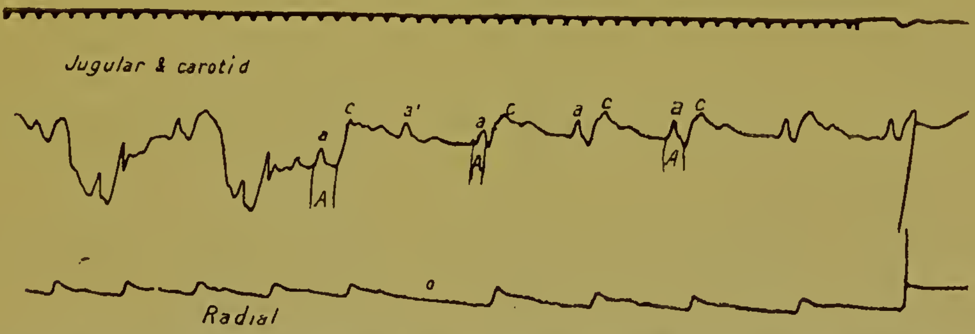

Fig. 28. Tracing of a pulse in the neck and of the radial pulse showing a variation in the *a*-c interval (*A*), and the dropping out of a radial beat at *o* due to partial heart-block. Note the shortening of the space *A* after the pause in the radial and the increase of the space *A* before and after the pause (*CASE 17*).

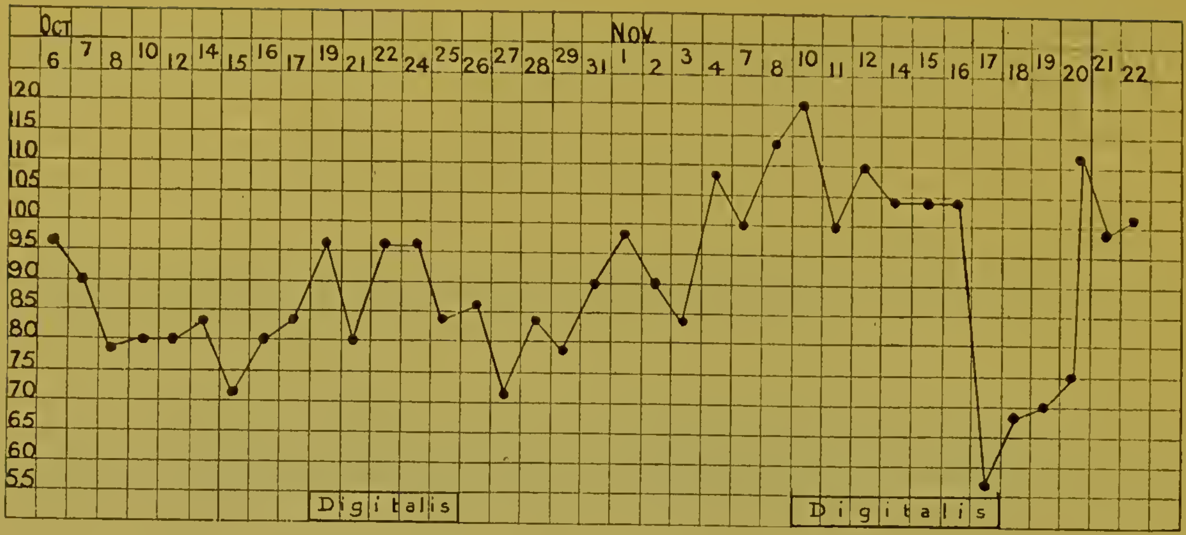

Fig. 29. Chart of *CASE 17.* From November the 17th to November the 20th the auricles were fibrillating.

DATE.	DRUG.	PULSE RATE.	BLOOD PRESSURE.	URINE.	SIZE.	REMARKS.
Oct.						
6		96			1½-5	
7		90	135	20		Dyspnœa, palpitation.
8		78	130	40		
10		80		52		Palpitation last night and this afternoon.
12		80		20		Palpitation for 1½ hours in night.
14		84		25		No palpitation for two nights, breathing short on slight exertion.
15		72				
16		80		46		
17		84		40		
18	Tr. Digit.			40		
19	ʒi p.d.	96		20		Feels well, short of breath on slight movement.
21		80		20		Feels well.
22		96		23		Feels heart thumping, some palpitation.
24		96		20		Vomited yesterday, headache, throbbing.
25	ʒvii Digit stopped	84		42		Vomited.
26		86		34		No vomiting, nausea.
27		72		32		Slight headache, otherwise better.
28		84		42		Slight headache, heart thumping in night.
29		78		44		Slight headache.
31		90	116	40		Last night palpitation and shortness of breath.
Nov.						
1		98	120	40		Still shortness of breath, no palpitation.
2		90	112	40		Still shortness of breath, no palpitation.
3		84	118	36		Still shortness of breath.
4		108	118	40		Still short of breath.
7		100	110	50		Very short of breath yesterday. Sleep disturbed by bad breathing.
8		114		54		Short of breath.
10	Tr. Digit	120	112	40		Breathing worse, thumping of heart.
11	ʒi p.d.	100	112	36		Frontal headache.
12		110	120	24		No headache, breathing better.
13			110	34		
14		104	106	30		Feels sick, frontal headache, breathing no better.
15		104	102	36		Feels sick, headache, appetite poor.
16		104	100	15	1½ 5	Feels sick, no headache, appetite poor.
17	ʒvii Digit stopped	56	94	12		Vomited four times in night, headache.

Date. Nov.	Drug.	Pulse Rate.	Blood Pressure.	Urine.	Size.	Remarks.
18		68	118	16		Retching through night, vomited this morning, feels very weak, headache. Breathing a little better.
19		70	120	10	1½-5	Vomited in night, retching frequent, headache better, still some headache.
20		75	110	20		No vomiting, bad headache.
21		98	130	22		Feels well, no headache or nausea, appetite fair.

CASE 18, male, aged 23. Normal rhythm. Mitral stenosis. Digitalis caused heart-block. Death from suffocative oedema of the lungs. P.M. report.

Admitted November the 4th, 1910, complaining of shortness of breath, palpitation and occasional spitting of blood.

History. In childhood the patient had suffered from scarlet fever and measles, but there was no history of rheumatism. Six years before admission he had coughed up some blood and he then noticed he was rather short of breath and suffered from palpitation. The breathlessness and palpitation had become very much worse during the few months prior to admission, so that he had not been able to follow his work as a labourer.

State on admission. The patient was quite comfortable when at rest and could lie flat in bed. The pulse was 92 beats per minute, and was regular, save for the occurrence of occasional extrasystoles. The apex beat was in the 5th interspace. The heart's dulness lay ¾ and 4¼ inches to right and left of the mid-sternal line. At the apex there was a rough presystolic murmur running up to the first sound, and a murmur following the second sound, so that the whole pause between the two sounds was filled by the two murmurs. There was no dropsy, and the urine was free from albumen.

Treatment and progress. The patient was kept at rest for nine days, and no drug was given. There was a slight irregular rise in temperature during the first week. The pulse rate varied from 108 to 76, the more rapid rate occurring when there was a rise of temperature. On November the 14th he was put on tincture of digitalis, 20 minims thrice daily, and this was continued till the 22nd, when he had taken 7½ drachms. He vomited several times on the 21st and 22nd, and the drug was stopped. The pulse rate fell to 66 beats per minute, and on one occasion, when the pulse slowed after exertion, occasional pauses were detected in the heart's action, which a tracing showed to be due to partial heart block (Fig. 30). There was a slight increase in the *a-c* interval when he was under the influence of the digitalis. Before taking the digitalis the extrasystoles had disappeared, and while taking the drug, the patient felt very well. This improvement, however, had set in before the digitalis was given. After the digitalis was stopped, the vomiting ceased and the patient continued to feel well so long as he kept quiet.

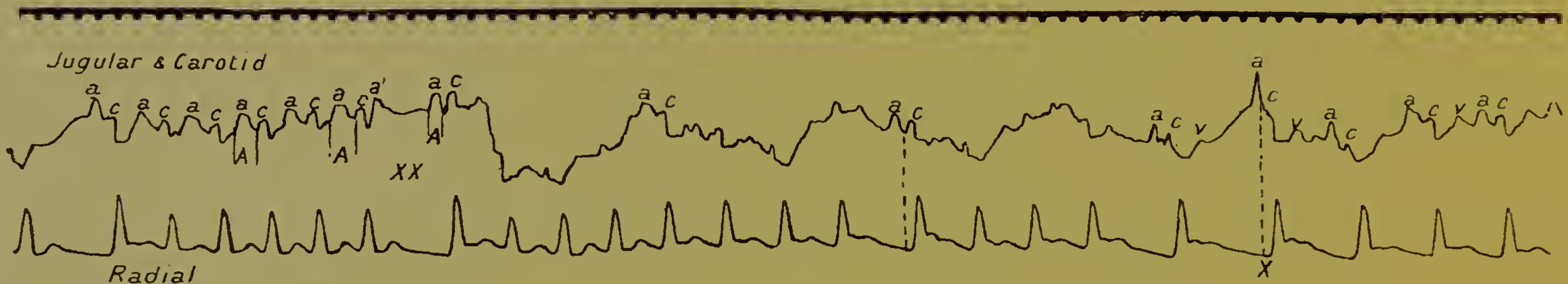

Fig. 30. Shows an irregularity due to phasic variations in the heart's rate. The rate is continuously varying, and during the slow phases the ventricular systole occasionally occurs independently of the auricular systole, as at *X*, where the high wave *a* appears at the beginning of ventricular systole. The increased height of this wave is due to the auricle contracting at the same time as the ventricle, so that the contents of the auricle are forced back into the veins. At *XX* the wave *a′* is not followed by a carotid wave (*c*) nor by a radial pulse beat. The *a-c* interval (space *A*) before *a′* is greater than the normal and greater than the *a-c* interval following. The increase in the length of the *a-c* interval and the falling out of the ventricular systole after *a* is due to partial heart-block from digitalis.

On the night of November the 30th he began to cough up large quantities of a pink frothy expectoration, which seemed to well out of his mouth. This continued for some hours, and then subsided. All the next day he continued to cough up some of the same material and felt very weak and ill. The lungs showed numerous fine crepitations all over. The pulse was full and rapid, and he sank and died soon after midnight on December the 1st (see Chart, Fig. 31).

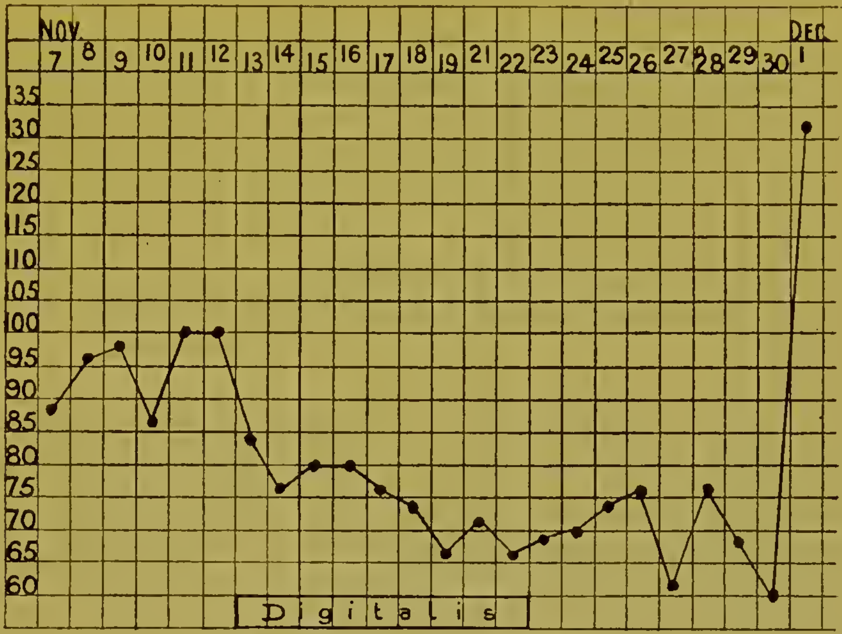

Fig. 31. Chart of *CASE 18.*

DATE. Nov.	DRUG.	PULSE RATE.	BLOOD PRESSURE.	URINE.	SIZE.	REMARKS.
7		88			¾-4¼	Sputum shows a few blood streaks.
8		96	116			Has some palpitation.
9		98	116	36		A little palpitation.
10		86	128	41		Has some cough.
11		100	112	63		Coughing attacks in morning.
12		100	110	62		Cough troublesome in night.
13		84	106	48		
14	Tinct. Digit.	76	112	35		Feels well.
15	ʒi p.d.	80	110	54		Feels well.
16		80	112	65	1¼-4¼	Feels well.
17		76	110	79		Feels well.
18		74	102	77		Feels well.
19		66	120	52		Feels well.
21		72	112	53		Vomited this morning, no headache.
22	ʒvii Digit.	66	112	45		Vomited four times in night.
23	stopped	68	110	41		No further vomiting, no appetite, no headache.
24		70	110	34		Appetite better, feels well.
25		74	110	40		
26		76	100	33		Feels better.
27		62				
28		76		53		Feels well.
29		68	100	71		Feels well, no cough.
30		60	100	56		
Dec.						
1		132				Coughing up large quantities of blood stained froth.
2						Died.

Post mortem report by Professor Woodhead.

Right lung. Weight 2 lbs. 1 oz.. Some old adhesions of upper and middle lobe; slight adhesions between lower and middle lobe at base; no recent pleurisy. Intense congestion throughout, with slight oedema and some consolidation. Peculiar brick-red colour. Clots in branches of pulmonary artery.

Left lung. Weight 1 lb. 10 oz.. The glands at root of left lung enormously enlarged and greatly congested; calcareous gland at root of lung. Intense congestion with some oedema as in other lung, more marked at base. Evidence of old pleurisy with a definite pigmented cicatrix near the apex of the lung. Well-marked adhesions between the two lobes. Cicatrix extends for a considerable distance into the lung, and is continuous with thickened pleura on surface; evidently an old and healed tuberculous cavity, distinctly localised and associated with calcareous gland at root of lung.

Right kidney. Weight $5\frac{3}{4}$ oz.. Capsule slightly adherent. Surface somewhat mottled, congested. At one point capsule firmly adherent to a depressed area of kidney, old infarction (?). Malpighian bodies fairly distinctly marked, some congestion of both cortex and medulla, vessels fairly patent, cortex if anything slightly thinned.

Spleen, (portion of). Evidently from enlarged spleen, soft, pulpy and congested. Malpighian bodies somewhat paler, standing out prominently with deeper coloured centre, pulp still more deeply coloured. Resembles a fibroid spleen. Depressions as though there had been infarction at two or three points.

Thyroid enlarged; parathyroid much enlarged.

Heart. Weight 13 oz. Adhesion of the pericardium over the left auricle. Glands all round the heart and around trachea enormously enlarged and greatly congested. Great congestion of tracheal mucous membrane. Post-mortem clots in both auricles.

Right ventricle considerably dilated.

Left ventricle. Wall very flaccid and flabby, pale. Ante-mortem clot in right ventricle beginning at apex and extending up into right auricular appendix. Pale endocardium, slight mottling, fatty (?). Adhesion of margins of mitral valve, marked fibrous tissue extending into musculi papillares.

Left auricle. All round base of mitral valve sharp calcareous points in thickened fibroid ring, thickened endocardium thrown into folds and very opaque. Muscle wall probably hypertrophied.

Right auricle. Wall comparatively thick as compared with left, only slight thickening of tricuspid cusps, no incompetence. Slight thickening of endocardium. Pectinate muscles quite distinct, consisting of bands with clear spaces between. Very firm white clot in auricular appendix.

Sinus of coronary vein very large and well-marked. Very slight thickening of cusps of the aortic valve. Thickening of margins of coronary cusps, slight thickening of wall of coronary arteries which, however, are quite patent and of considerable size. A good deal of fat in *A- V* groove.

CASE 19, female, aged 30. *Normal rhythm. Mitral stenosis. Rheumatic history. Digitalis and strophanthus produced vomiting and slightly decreased the pulse rate.*

Seamstress, admitted October the 21st, 1909, complaining of breathlessness on the slightest exertion.

History. The patient had had rheumatic fever at 14, 17 and 21 years of age, and hæmoptysis in September, 1907. In September, 1908 she had a sudden loss of consciousness, followed by a right hemiplegia ; from this she gradually recovered and was fairly well till three weeks before admission, when she became very short of breath.

State on admission. The patient was a small puny woman, the face was somewhat dusky. The pulse was regular and varied from 50-70 beats per minute. The apex beat was in the 6th interspace, $\frac{3}{4}$ inch outside the nipple line and forcible. There was a long crescendo murmur running up to the first sound at the apex and the second sound was reduplicated. At times a short whiff was heard after the second sound at the apex.

Treatment and progress. The patient was kept at rest with no special treatment for 18 days. There was little improvement in her condition, her chief complaint being breathlessness on exertion. On November the 8th she was put on tincture of digitalis, 15 minims thrice daily, and this was continued till November the 15th when she had taken 5 drachms. Her pulse rate fell to between 42 and 50. She was very sick and vomited. After the drug was stopped she felt fairly comfortable but was still breathless on exertion. She had digitalis on two other occasions from November the 27th to December the 1st (4 drachms) and from January the 13th to the 19th (6 drachms). In both instances the medicine produced vomiting, on the last occasion headache also, and the pulse rate fell to between 60 and 50.

On February the 10th she was put on tincture of strophanthus, 15 minims four times a day, and this was continued till the 18th when she had taken 7 drachms. This produced diarrhœa and nausea, and the pulse rate fell to 44 after the diarrhœa stopped.

There was a gradual improvement in her condition, in so far as she could undertake effort with less distress, till her discharge on March the 2nd. It is doubtful whether the drugs had any good effect, the rest alone being the probable cause of the improvement (see Chart, Fig. 32).

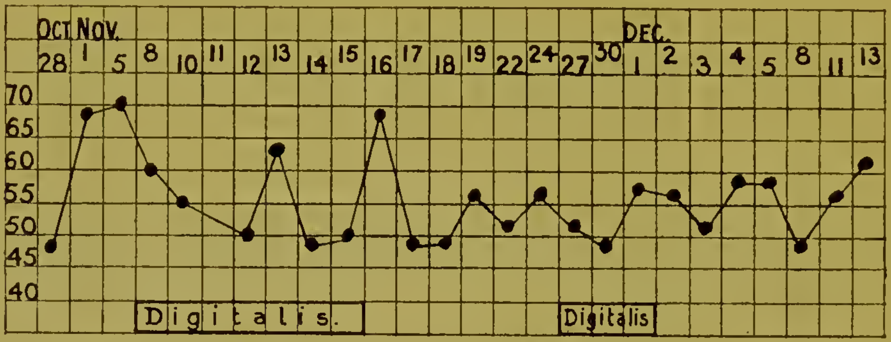

Fig. 32. Chart of *CASE 19.*

Date.	Drug.	Pulse Rate.	Blood Pressure.	Size.	Urine.	Remarks.
Oct.						
10		84				
24		52			28	
28		48			28	
Nov.						
1		68			40	
5		70			27	
8	Tr. Digit.	60			35	
10	45 minims p.d.	55	98		32	
11			90		18	Vomited once this morning, sleeps badly.
12		50	90	½-5½	22	
13		64			34	
14		48			47	
15		50	100		31	
16	ʒv Digit. stopped	68				Vomited.
17		48	90		18	Comfortable, but sleeps poorly.
18		48	90		25	
19		56	98		24	Feels better.
22		52			28	Feels well.
24		56	92		46	
27	Tr. Digit.	52		¾-5	40	
30	ʒ i p.d.	48	96		36	
Dec.						
1	ʒiv Digit. stopped	57	92		32	Feels sick, vomited.
2		56			26	
3		51	96	¾-4¾	25	Feels better.
4		58	96		26	
5		58			58	
8		48			28	Feels well.
11		56	92		34	
13		62			40	
Jan.						
2		58	92		32	
3			90		38	
6		72			40	
9		96			36	
11		54	92	½-4¾	10	
13	Tr. Digit. ʒi p.d.	44	92		34	

Date.	Drug.	Pulse Rate.	Blood Pressure.	Size.	Urine.	Remarks.
Jan.						
14		72	88		36	Easily becomes breathless.
17		48	92		40	Vomited at 6 a.m., feels well but thinks she is rather more breathless.
18		44	88	½-4½	40	Feels better. No more sickness.
19	ʒvi Digit. stopped				8	Been vomiting, severe frontal headache.
20		46			15	Feels very seedy, menstruating.
23		48			34	Feels well. Less breathless after exertion.
28		48		½-4½	27	Feels well.
30		72			37	Feels very well.
Feb.						
9		68	96	½-4½	34	Very breathless after exertion.
10	Stroph. ʒi p.d.				36	
12		60		½-4	25	Less breathless after exertion.
14		52			25	Feels very well.
16		46	96		24	
17		72	106	¾-4½	13	Feels better. Diarrhœa to-day.
18	ʒvii Stroph. stopped	60			17	Diarrhœa severe yesterday (12 motions), less severe to-day. Slight headache, nausea, otherwise fairly well.
21		44			23	Feels well now, felt quite well after exercise.
23		44	90		32	
25		62			40	
26		72			22	Feels well.
28		60	102		26	
March.						
2		52				Feels well.

CASE 20, female, aged 34. *Normal rhythm. Mitral stenosis. Digitalis had no apparent effect on the heart or blood pressure.*

Admitted April the 11th, 1910, complaining of shortness of breath upon the slightest exertion and pain in the left chest.

History. The patient was quite well till two years before admission, but had suffered from weakness, breathlessness and pain in the chest during the two years. She had never had rheumatism or any serious illness. She was married and had had five children.

State on admission. The patient was a small woman and well nourished, the cheeks were flushed and slightly dusky. She could lie comfortably on a low pillow but was short of breath on exertion. The pulse was regular, 64 beats per minute, and the blood pressure was 102 mm. Hg.. The apex beat was in the 6th interspace outside the nipple line. The heart's dulness lay 0 and 4½ inches to right and left of the mid-sternal line. At the apex there was a presystolic murmur running up to the first sound. The second sound was reduplicated. At the aortic area the sounds were clear.

Treatment and progress. The patient was kept at rest without further treatment till the 16th, when she was put on tincture of digitalis, 15 minims four times a day; this was continued till the 20th. The notes of the results of the exhibition of digitalis are unfortunately limited to the pulse rate and urine secretion, and these show no definite effects from the drug. She undoubtedly felt better afterwards and was again placed on tincture of digitalis, 15 minims four times a day on May the 15th, and it was continued till the 20th. On this date she was sick and vomited, and suffered much from headache. This symptom had disappeared on the following day, and after this she felt very well, although there was no appreciable effect upon the heart rate or rhythm, except for the occurrence of extrasystoles after exertion. She was discharged from the hospital on May the 23rd very greatly improved (see Chart, Fig. 33).

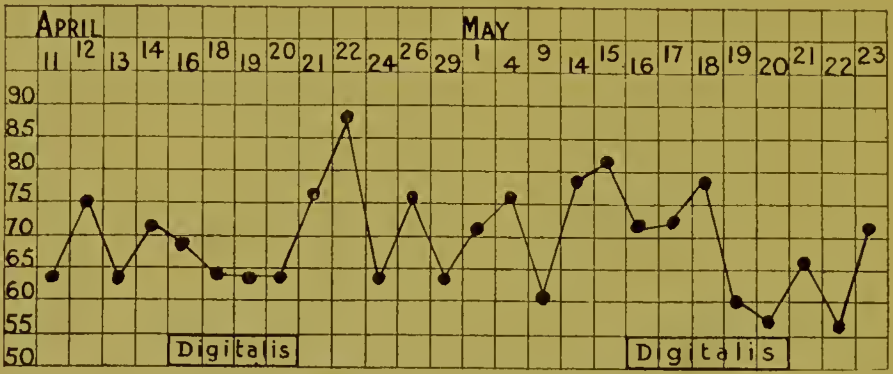

Fig. 33. Chart of *CASE 20.*

Date.	Drug.	Pulse Rate	Blood Pressure.	Size.	Urine.	Remarks.
April.						
11		64	102	-4½	26	Short of breath, cough troublesome.
12		75			16	
13		46			16	Little better.
14		72			10	
16	Tr. Digit. ʒi p.d.	68			38	
18		64			18	Feels better.
19		64			18	
20	ʒv Digit. stopped	64	112		26	
21		76			28	
22		88			18	
24		64			18	
26		76			20	
29		64			28	
May.						
1		72			12	
4		76			24	
9		60			14	
14		78			20	
15		81			14	
16	Tr. Digit. ʒi p.d.	72	128		20	Feels well.
17		73			19	
18		78			19	
19		60	112	-4¼	15	Feels very well.
20	ʒv Digit. stopped	57	106		4	Feels sick, vomited in the night. Frontal headache.
21		66	116		14	Feels quite well, appetite good. Headache gone.
22		56			7	
23		72	104		10	Feels quite well.

CASE 21, male, aged 36. Normal rhythm. Mitral stenosis. Rheumatic history. Digitalis produced vomiting and partial heart-block, but did not materially slow the pulse.

Admitted August the 4th, 1910, complaining of shortness of breath and over left chest.

History. He had had three attacks of rheumatic fever between the ages of 8 and 20, the fourth attack being in 1906. After each attack pain in the left chest was felt for some time. From February, 1910, he had suffered much from shortness of breath and pain in the chest, especially on exertion.

State on admission. The patient was healthy looking, the pulse regular, the apex beat being in the 5th interspace. The heart's dulness lay 0 and 3^{8} inches to right and left of mid-sternal line. At the apex there was a short rough murmur terminating in a snapping first sound. (At times this murmur was represented by a distinct sound of a soft character).

Treatment and progress. When at rest the patient suffered from no discomfort, but very slight effort induced the pain and breathlessness. For 10 days he was kept at rest and during this time his pulse rate varied from 74 to 110 beats per minute and his blood pressure from 110 to 122 mm. Hg.. He was then put on aconitine, but although the drug was pushed till distinct symptoms were produced, such as dryness in the throat, the pulse rate kept up, and increased in rate on the whole, while the blood pressure fluctuated between 114 and 140. He had been taking aconitine from August the 18th to September the 6th. He remained without drugs till September the 10th when he was given tincture of digitalis four times a day till September the 16th; he had then taken 5½ drachms. On September the 15th he vomited but there was no effect on the heart's rate nor on the blood pressure. On the 16th the pulse was occasionally intermittent; simultaneous tracings of the jugular and radial pulses showed a partial heart block (Fig. 34.). It

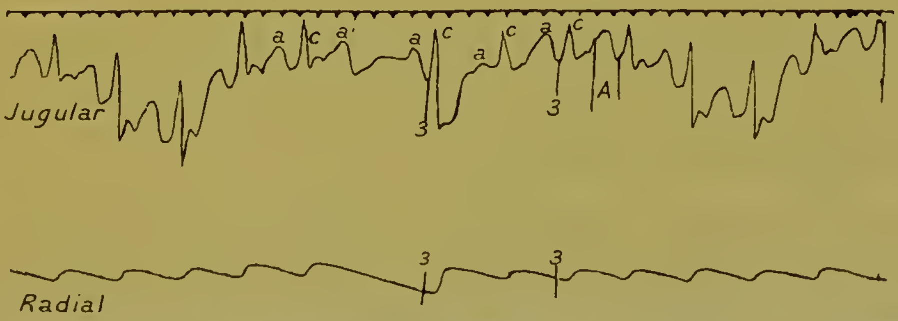

Fig. 34. Shows a pause in the radial and the absence of a *c* wave after the auricular wave *a* due to partial heart-block. The *a-c* interval (space *A*) is increased.

was not detected after this date. The patient was discharged feeling much better, in that he could go upstairs with comfort, but a month after he appeared at the out-patient department with a recurrence of the pain and distress in breathing.

DATE.	DRUG.	PULSE RATE.	BLOOD PRESSURE.	URINE.	REMARKS.
Sept.					
6		100	130	54	
7		104	134	68	
8		106	130	70	
9		100	116	60	
10	Tr. Digit.	100	124	72	
11	ʒ i p.d.	102	128	72	
12		90	120	82	
13		96	100	74	
14		94	108	59	Vomited.
15		100	108	72	Vomited violently.
16	ʒvss Digit. stopped	96	120	72	Headache, pulse intermittent, no nausea. (partial heart-block.)
17		98	124	62	Better.
18		96	128	67	
19		94	126	70	
20		94	124	70	
21		98	125	68	Feels much better, can go upstairs with less distress.

CASE 22, female, aged 32. *Normal rhythm. Mitral stenosis. Rheumatic history. Digitalis had no effect upon the heart.*

Married, admitted November the 9th, 1910, complaining of pain in the chest and shortness of breath.

History. She had rheumatic fever at 9, 18 and 31 years of age. She had had five children and was five months pregnant. She had been short of breath for a long while, but had gone through her pregnancies and confinements with very little trouble. During the three weeks prior to admission her breathlessness had increased.

State on admission. The patient was well nourished and healthy looking. She could walk about quietly without distress, but breathlessness was easily induced on exertion. The pulse was regular. The heart's dulness lay 1¼ and 5 inches to right and left of the mid-sternal line. The apex beat was in the 5th interspace. There was a systolic murmur, loudest at the apex and conducted into the axilla. There was also a presystolic murmur running up to the first sound and a short murmur following the second sound. The last two murmurs were only heard over a limited area around the apex.

Treatment and progress. The patient was kept at rest and given no drug for a week after admission. The murmurs were found to vary, the presystolic and diastolic often disappearing when resting but usually reappearing after exertion. On November the 16th she was given 15 minims tincture of digitalis three time a day and this was continued till the 23rd, when she had taken 5 drachms. It was stopped because it caused severe headache ; there was no effect on the pulse rate or the blood pressure. She felt very well after the headache passed away and was able to undertake effort with much less distress. She was discharged on December the 6th feeling very well.

DATE.	DRUG.	PULSE RATE.	BLOOD PRESSURE.	SIZE.	URINE.	REMARKS.
Nov.						
11		86	114		11	
12		88			40	
13		90			15	
14		88			30	
15		86		1¼-5	12	
16	Tr. Digit.	80	98		28	
17	45 m. p.d.	80	98		10	
18		88	102		42	Feels better in every way.
19		88	106	1¼-5	12	
20		90			10	
21		90			24	
22		75			46	Headache, otherwise feels well.
23	ʒv Digit. stopped	85			22	Headache severe, constipation.
24		80	100	¾-5	38	
25		88				
26		72				
Dec.						
2		80	106		56	Feeling very well for past four days. Headache disappeared when bowels well opened.
4		84	102		58	Feels well.
5		80			60	
6						Been up, feels very well.

CASE 23, female, aged 50. Normal rhythm, Mitral stenosis. Rheumatic history. Numerous extrasystoles and pulsus alternans. Digitalis had no effect upon the heart rate or upon the occurrence of extrasystoles.

Admitted April the 19th, 1910, complaining of great shortness of breath and exhaustion upon the slightest exertion.

History. Rheumatic fever at 9. She was married and had five children. For five years she had been very short of breath, and this had been so bad for the few months preceding admission that she could not lie down in bed. In the night she was sometimes distressed by attacks of breathlessness (cardiac asthma). She had had attacks of faintness and exhaustion, even when resting, for many years but never lost consciousness. There were other attacks which came on every few months; in these she lost consciousness, was convulsed, and passed urine.

State on admission. The patient was well nourished, the face was dusky, and she lay propped up in bed. The pulse was 96 per minute, large and irregular as a result of frequent extrasystoles. After each extrasystole the pulse alternated. The blood pressure for the large beats was 174 mm. Hg.. The apex of the heart was in the 5th interspace, just outside the nipple line and 4½ inches from mid-sternal line. At the apex there was a systolic murmur and a faint presystolic running up to the first sound. The last murmur was frequently absent.

Treatment and progress. The patient was evidently very distressed on admission ; the slightest exertion, such as turning in bed, brought on dyspnœa, and it seemed from her history that the exhaustion arose from attempts to perform her many household duties when the heart was enfeebled. After 10 days rest in bed she had greatly improved. The attacks of cardiac asthma had disappeared and she could turn in bed without dyspnœa. From the 6th to the 13th, she was given iodide of potassium. During that time she took altogether 225 grains, but there was no apparent effect. The extrasystoles continued to be frequent, but the improvement continued so that she felt very comfortable in bed and could walk about without distress. On May the 16th she was given tincture of digitalis, 15 minims three times a day ; this was continued till the 20th when she had taken altogether 3¾ drachms. On the 20th she vomited and had a good deal of headache. The breathing was easier but the extrasystoles persisted. The digitalis did not affect the pulse rate. On the 21st she felt quite well and there was no headache. The patient continued to improve and was discharged on June the 3rd greatly improved in health, though the extrasystoles were as frequent but the *pulsus alternans* was much less marked (see Chart, Fig. 35).

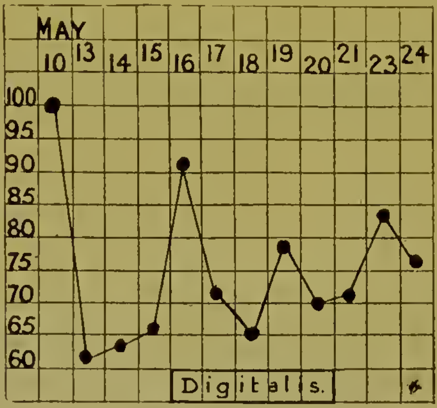

Fig. 35. Chart of *CASE 23*.

DATE.	DRUG.	PULSE RATE.	BLOOD PRESSURE.	URINE.	REMARKS.
April 26		96	174	24	Very breathless on slight exertion. Occasional attacks of breathlessness during night.
May 5		72	124	20	
6				25	Feels less breathless. No attacks of breathlessness during night for a week.
8		104		18	

Date	Drug.	Pulse Rate.	Blood Pressure.	Urine.	Remarks.
May					
9		60		20½	
10		100	142	40	
13		62	152	42	Feels very well.
14		64		17	
15		67		17	
16	Tr. Digit.	92	172	34	Feels very well.
17	45 m. p.d.	72		27	
18		65		48	
19		78	156	37	Feels very well.
20	ʒiii & m. 45 Digit. stopped	70		18	Vomited this morning, frontal headache, otherwise feels well. Breathing easy.
21		72	126	42	Feeling quite well again. No headache.
23		84	150	38	Feels quite well.
24		76	136	27	
26				51	
27		66		40½	
30		72	130	36	
31		78		44	
June					
6		72	180	22	Feels quite well, no more attacks of breathlessness.

CASE 24, female, aged 24. *Normal rhythm. Mitral stenosis. Rheumatic history. Digitalis and squills decreased the heart rate and caused heart-block, sinus irregularity, extrasystoles and "pulsus alternans."*

Upholstress, admitted February the 26th, 1910, complaining of shortness of breath and palpitation on the slightest exertion.

History. The patient suffered from scarlet fever in childhood, rheumatic fever at 12, and chorea at 14. She was laid up with weakness and dropsy at 16.

State on admission. She was pale and spare and lay propped up in bed. The pulse was regular at 72 beats per minute. The heart's dulness lay 2 and 5¾ inches to right and left of the mid-sternal line. The apex was in the 5th interspace. There was a diastolic thrill over the apex. At the apex there was a rough presystolic murmur, running up to the first sound, and a soft murmur following the second sound and separated from the presystolic by a brief interval when the rate was slow, but running into it when the rate was rapid. A systolic murmur was heard and was loudest over the middle of the sternum.

Treatment and progress. The patient was kept most of the time in bed for eight days after admission. She improved considerably and at the end of a week she was able to walk up a flight of stairs with less distress. On March the 6th she was put upon tincture of digitalis, 15 minims four times a day, and this was continued till the 18th when she had taken 11¾ drachms. During the time she was on digitalis her condition varied, sometimes she was able to take exercise with little discomfort, at other times she suffered a good deal from breathlessness. About the 14th she began to suffer from headache, which became very severe, and on the 18th vomiting set in and the digitalis was stopped. Her pulse rate had fallen as low as 40 beats per minute on the 15th, other changes in the rate also appeared, especially after exertion. The heart always beat very fast after exertion, but it fell to

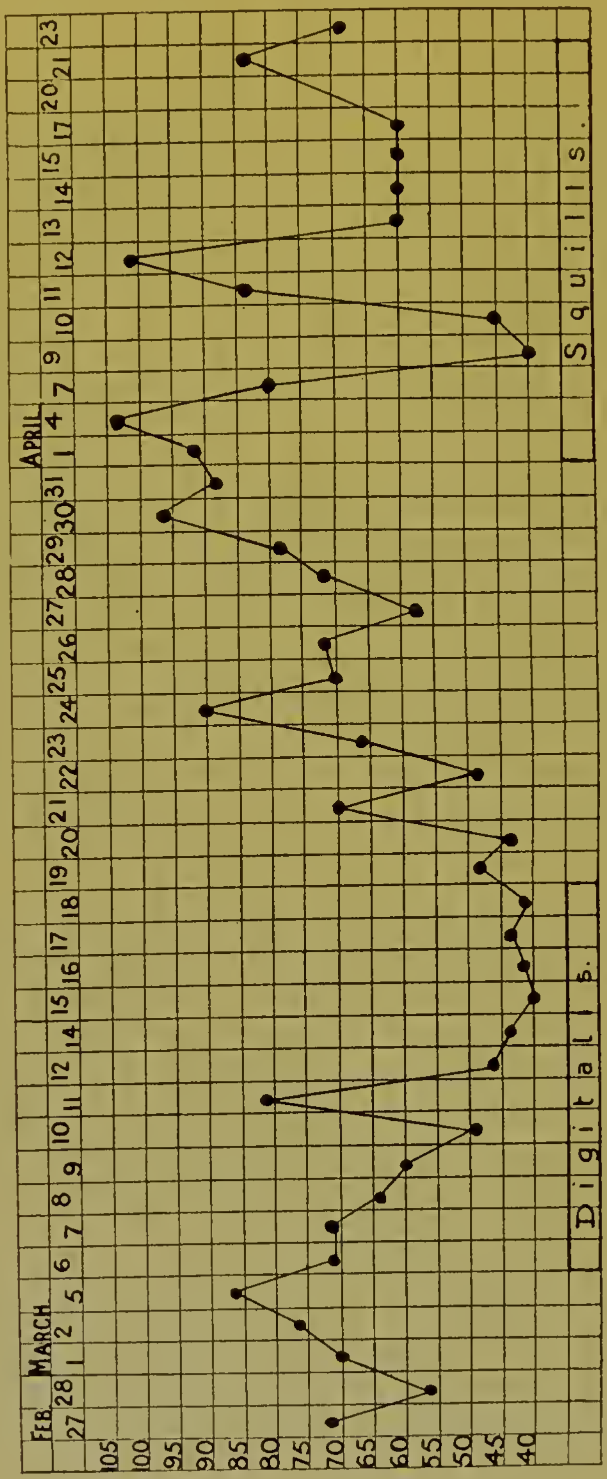

Fig. 36. Chart of *CASE 24.*

between 40 and 50 beats per minute after three or four minutes. As the pulse became slower after exertion, three forms of irregularity appeared, namely, sinus irregularity, extrasystoles, and heart-block. The blood pressure showed little change before and after the digitalis. It fluctuated before the drug was given from 95 to 116 mm. Hg.. When the vomiting and headache set in, the blood pressure was 112. A few days after the drug was stopped, it was 118. For a week after the digitalis the patient felt very well. The headache and sickness speedily disappeared, and the patient felt very much better, the breathing being easier after exercise and the appetite improving. The pulse rate then began to increase and the patient was given tincture of squills, 15 minims four times a day. This was continued from April the 1st till the 21st, when the patient had taken 20 drachms. The squills had the same effect as the digitalis in slowing the pulse and improving the patient's condition, and was accompanied by much less headache and digestive disturbance. The heart showed the same reaction after exercise, only the heart-block was more marked.

The patient left the hospital on the 30th much improved and able to resume her work (see Chart, Fig. 36).

(A full description of the irregularities of this patient has been given by Turnbull (*Heart*, 1910-11, II, 15).)

DATE.	DRUG.	PULSE RATE.	BLOOD PRESSURE.	SIZE.	URINE.	REMARKS.
Feb.						
27		72			36	Very short of breath.
28		56	114	2-5¾	14	Feels much better, sleeps well without pillows.
March						
1		70	112	1½-6	24	Feels better, can lie almost flat without distress.
2		76	128	1½-5½	32	Feels better.
5		86	130	1½-5¾	24	Feels better, less breathless.
6	Tinct. Digit. ʒi p.d.	72			40	
7		72			30	Feels well, but dyspnœa after exertion.
8		64			40	
9		60	132	1¼-5½	44	More breathless after exercise.
10		48			56	Not quite so well, heart thumping, slight headache.
11		82			23	Feeling very well.
12		46			56	Feels well. Occasional extrasystoles after exercise.
14		44		1¼-5½	45	Not feeling quite so well. Marked sinus arrhythmia after exercise. Few extrasystoles.
15		40			29	Feels fairly well, headache this morning.
16		42			33	
17		44			22	Not feeling so well, headache.
18	ʒxi¾ Digit. stopped	42	116	1¼-5½	24	Not so well, headache severe. No sleep last night and vomited.
19		48			28	
20		44	132	1¼-5½	40	Very well, no headache, appetite good. Breathing better than ever before. One auricular impulse blocked. Sinus arrhythmia. Occasional extrasystoles after exercise.
21		70			45	No dyspnœa but some little palpitation after exercise. Sinus arrhythmia more after exercise.
22		48			43	

Date.	Drug.	Pulse Rate.	Blood Pressure.	Size.	Urine.	Remarks.
March						
23		66			42½	Sinus arrhythmia, extrasystoles.
24		90		1¾-5¾		Feels well, slept well. Sinus arrhythmia after exercise.
25		70				
26		72-78				
27		57				
28		72				
29		78				
30		96	114	1¼-5¼		Feels well. No dyspnœa after exercise, no sinus arrhythmia.
31		88	124			
April						
1	Tinct. Squills ʒi p.d.	92				Not feeling so well, some palpitation and dyspnœa.
4		104		1¼-5½		Feels well.
7		80		1¼-5½		Not feeling well, low spirited, headache.
8						Feels well.
9		40				Feels quite well,
10		45		1¼-5¼		Feels very well.
11		84				Marked sinus arrhythmia after exercise.
12		102				Marked sinus arrhythmia.
13		60				Heart-block.
14		60				Heart-block and irregularities (extra systoles and pulsus alternans) after exercise.
15		60				
17		60				Heart-block and alternation after exercise.
20						Heart-block after exercise.
21	ʒxx Squills stopped	84		1¼-5		Feels poorly, bilious. Some palpitation and a little short of breath.
23		68				Palpitation occasionally but not so frequently as on admission. No pain. No palpitation on exertion, but slight dyspnœa. All irregularities gone, even after exercise.

CASE 25, female, aged 31. *Normal rhythm. Mitral stenosis. Digitalis and strophanthus improved the patient and decreased the heart rate.*

Dressmaker, admitted October the 25th, 1910, complaining of weakness and shortness of breath.

History. The patient had suffered from her heart for 9 years. In the spring of 1909 she had had influenza, which left her with a cough. She expectorated several clots of blood in July, 1910. She gave no history of rheumatism or chorea but had frequently suffered from sore throat.

State on admission. She was pale but fairly well nourished, and was comfortable when lying down with the shoulders raised. The pulse was quite regular, its rate was about 80 per minute. The apex beat was in the 5th interspace and a thrill preceded its impact. The heart's dulness lay 1 and 4 inches to right and left of the mid-sternal line. At the apex there was a murmur preceding and running up to the first sound and another murmur following it; there was also a murmur following the second sound. The presystolic and diastolic murmurs were only heard at the apex, while the systolic murmur was heard over the whole of the cardiac region and in the axilla.

Treatment and progress. After resting in bed for a week a slight improvement took place and the pulse rate slowed. She was put on tincture

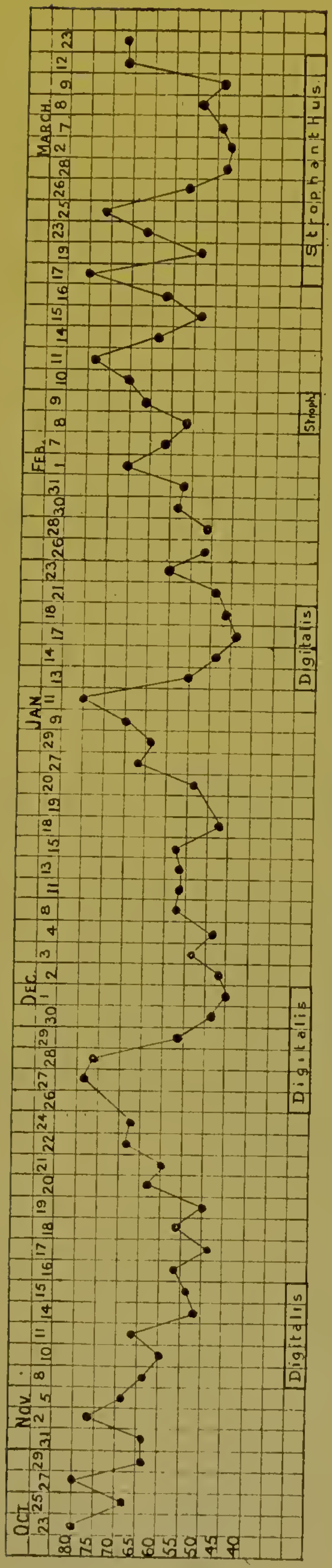

Fig. 37. Chart of *CASE 25.*

of digitalis, 20 minims thrice daily, on November the 8th. This was continued till the 15th when she had taken 6½ drachms. The effect of the digitalis was to slow the pulse and cause the patient to be conscious of the heart's beat. By the 26th the pulse rate was somewhat increased, and the patient was again put upon the digitalis, 15 minims four times a day. This was continued till December the 2nd when she had taken 5½ drachms. This again slowed the pulse and produced a marked sinus irregularity after exertion. She was conscious of her heart thumping in a distressing manner, and she felt nauseated. The day after the drug was stopped she felt very well and continued to do so for the next three or four days. She was kept quiet after this and given no medicine for a time. She became slightly worse and became more breathless after exertion. In some observations on the 7th, the sinus slowing occurred at intervals after the heart had quieted down after exertion. On January the 13th she had attacks of breathlessness when lying in bed, and was again put upon the digitalis, 15 minims four times a day; this was continued till the 19th when she had taken 6 drachms. She felt better after taking three drachms, breathing more easily, but on the 18th she had nausea, vomiting and headache, and the pulse rate had fallen to 44. For the next ten days there was marked sinus irregularity while at rest and occasionally interpolated extrasystoles were detected after the heart had slowed down after exercise. They disappeared as the heart rate increased.

The patient began to be more breathless and on February the 8th, 1910, she was put upon tincture of strophanthus, 15 minims four times a day. This was stopped after taking 1½ drachms, as she began to menstruate and was not feeling well. The same doses were resumed on the 17th and continued till March the 12th, when she had taken 23 drachms. The heart gradually slowed and she was feeling fairly well on the whole. On March the 8th and the 9th when the heart was slower, occasional extrasystoles were detected after exertion. She was discharged on April the 12th, 1910, still taking 15 minims of strophanthus, three times a day. She reported herself on the 23rd as being on the whole fairly well but still having difficulty in breathing in walking up a hill (see Chart, Fig. 37).

DATE.	DRUG.	PULSE RATE.	SIZE.	URINE.	REMARKS.
Oct.					
23		30	1-4		
25		68			
27		80			
29		64		42	
31		64		44	
Nov.					
2		76		36	
5		68		45	
8	Digit. ʒi p.d.	64		40	
10		60		52	
11		66		49	
14		52		36	Conscious of every heart beat.
15	ʒviss Digit. stopped	54		40	Feels beats only occasionally.

Date.	Drug.	Pulse Rate.	Size.	Urine.	Remarks.
Nov.					
16		56		40	
17		48		16	
18		56		32	
19		50	1-4	24	
20		64		26	
21		60		42	
22		68		20	
24		67		31	Slight dyspnœa after exercise.
26	ʒi p.d. Digit.		1-4	40	
27		78		26	Feels stronger, breathing easier.
28		76			
29		56		31	
30		48		40	
Dec.					
1		40		40	Not feeling quite so well, a little faint, but appetite less good, bumping of the heart after exercise.
2	ʒvss Digit. stopped	42		28	Not feeling well. Nausea. Occasionally feels heart a little.
3		54		23	Feels quite well.
4		48	1-4	30	Feels well.
8		57		40	Feels heart beating unpleasantly, more breathless, wants to sit up. Yesterday had some pain in left breast.
11		56		48	Breathless after exertion.
13		56		40	Feels quite well, no dyspnœa or giddiness.
15		57		32	
18		46		24	Not feeling so well, palpitation again and trouble in breathing.
19					Dyspnœa came on suddenly last night when lying without her pillows, had to sit up.
20		54		50	Breathing easier.
27		66	¾-4	40	Feels very well.
29		64		38	
Jan. 1910.					
3				32	Feels fairly well. Occasional slight headache, consciousness of heartbeat.
5				23½	
8				28	
9		70		32	
11		80	1-4¼	26	Been up, feels breathless, still some pain now slight, with feeling of tension about top of sternum.
13	ʒi p.d. Digit.	55			
14		48		18	
16				20	Felt very well yesterday, breathing easier.
17		44		8	Not quite so well, feels a little sick, vomited this evening. Breathing much easier.
18		46	½-4¼	22	Better. Slight nausea after taking medicine but soon disappears. No dyspnœa after exercise.
19	ʒvi Digit. stopped			16	Headache, nausea, vomiting, otherwise feels well. Breathing easy.
20				6	Better, breathing easy.
21		48		26	
23		60		17	Feeling very well, breathing easy.
25				40	
26		52		18	Feels very well.
28		51		40	Feels well.
30		58		35	
31		57	¾-4½	38	
Feb.					
1		70		20	

DATE.	DRUG.	PULSE RATE.	SIZE.	URINE.	REMARKS.
Feb.					
3				25	Feels well.
7		62		40	
8	Stroph.	56		19	Feels breathless and ill, palpitation, pain in left chest last night.
9	ʒiiss Stroph. stopped	66		29	
10		70		17	
11		78	1-4	13	Feels very ill, all kinds of complaints.
14		64		9	Feels very well, breathing better. Less dyspnœa.
15		53		17	
16		62		10	
17	Stroph.	80		5	
19		54		14	
23		66		40	
25		76		19	
26		56	½-4½	37	Appetite poor now, otherwise well.
28		47		13	Feels well, no nausea.
March					
2		46	½-4½	34	
4				22	Some nausea, otherwise feels well.
7		48		20	Feels very well, no nausea.
8		54		20	
9		48		9	
10				36	
12	ʒxxiii Stroph. stopped	72			Discharged feeling well.
23		72	1-4¾		Called at Out-Patient department, feeling very well.

CASE 26, female, aged 45. *Normal rhythm. Mitral stenosis. Strophanthus caused diarrhœa on two occasions, but had no appreciable effect on the heart rate.*

Admitted March the 3rd, 1910, complaining of shortness of breath, pain over the front and left side of the chest and cough.

History. The patient had had vague rheumatic pains in her joints for one year. She had had cough at times for many years but more during the five months preceding admission. She sometimes brought up half a cupful of sputum, yellow and occasionally streaked with blood. She was losing weight. She was married and had four children and one miscarriage.

State on admission. The patient was a small wasted woman. The pulse was regular ; its rate was 84 per minute. The apex beat was in the fifth interspace outside the nipple line. The heart's dulness lay 1½ and 4½ inches to right and left of the mid-sternal line. At the apex there was a presystolic murmur running up to the first sound. There was a soft murmur following the first sound, the second sound was reduplicated and followed by a short murmur. At the aortic area the second sound was markedly reduplicated. The systolic murmur was best heard over the middle of the sternum. At the base of the left lung there was a patch of dulness over which the breathing was bronchial in character. In the neighbourhood there were numerous râles and rhonchi.

Treatment and progress. On March the 5th the patient was put on tincture of strophanthus, 15 minims four times a day, and this was continued till the 9th, when she had taken 5½ drachms. On the 7th she was seized with diarrhœa and on the 9th there was a good deal of abdominal pain in addition. The diarrhœa persisted for four days and she was given castor oil on the 10th and 11th. She had two motions on the 11th and the diarrhœa ceased. The heart was not affected in any appreciable way. The patient seemed better after this and there was less cough. On March the 19th she was again given 15 minims of the tincture of strophanthus; it was continued till the 22nd, when she had taken 3¾ drachms. Diarrhœa set in and there was some abdominal pain. On the 23rd she was given castor oil and in a couple of days the diarrhœa had stopped. Again there was no appreciable change on the heart, though the patient felt better afterwards. She was discharged on April the 4th only slightly improved, the improvement was probably due to the rest and proper feeding.

Date.	Drug.	Pulse Rate.	Size.	Urine.	Remarks.
March					
3		88	1½-4¾	20	Dyspnœa and cough troublesome.
4		76		40	
5	Tr. Stroph.	84		35	
6	ʒi p.d.	92		12	
7		68		16	
8		84		18	Diarrhœa, loose offensive stool,
9	ʒvss Stroph. stopped	84		8	Pain in abdomen.
10		76		18	Abdominal pain.
11		80		18	
12		68		16½	Better, diarrhœa stopped.
14		68		15	
16		72		16	
18		80		16	Cough better, no pain.
18	Tr. Stroph.	76	-5	22	
20	ʒi p.d.	80		11	
21		78	1-5	11	Feels well. Some dyspnœa after exercise.
22	ʒiii & m. 45 Stroph. stopped	72		19	Diarrhœa, liquid offensive stool. Abdominal pain travels down midline before bowels are moved. Slight headache.
23		70		16	Better, little diarrhœa this morning.
24		82		14	Severe headache, still diarrhœa.
25		80		18	Better.
31		80		48	Feels well.
April					
4		60	⅜-4½	44½	Feels well, cough troublesome.

CASE 27, male, aged 16. *Normal rhythm. Mitral and aortic disease. Digitalis produced heart-block, extrasystoles and pulsus alternans, it increased the flow of urine, but had no effect on the auricular rate.*

Admitted October the 20th, 1910, complaining of shortness of breath, pain in the left chest and swelling of the legs and abdomen.

History. The patient had been well up till five years of age, when he began to be short of breath. From this age until admission he had been five times in hospitals. There was no history of rheumatism or sore throat. For some weeks before admission his breathing had been getting worse and his legs had begun to swell.

State on admission. The patient lay propped up in bed; the breathing was laboured. The face was pale, puffy and rather distressed looking. The radial pulse was large, collapsing and regular. The apex beat was large and diffuse outside the nipple line in the fifth and sixth interspaces. There was a rough systolic murmur at the apex and at the aortic area there was a faint diastolic murmur. Both bases of the lungs behind were dull, and there were numerous fine crepitations with deep breathing. The jugular veins were full and pulsating. The liver extended three inches below the costal margin and pulsated. Both the liver and jugular pulsations were of the ventricular form as a rule, but occasionally there was a small auricular wave in each. There was some fluid in the abdominal cavity, and the legs and thighs were swollen. There was a slight trace of albumen in the urine.

Treatment and progress. The patient was very ill on admission. On the day after admission, he vomited and expectorated some blood-stained sputum. On October the 23rd he was found in a state of collapse, the pulse was small, rapid (140-150) and regular, the extremities were cold, the face pallid, the ears blue. He was very restless, the *alae nasi* were working, the breathing was distressed. After an inhalation of oxygen and a hypodermic injection of digitalin he rallied. Some hours after he had another attack and again rallied in half an hour. On the following day he was put on tincture of digitalis, 20 minims three times a day, and he gradually improved, the urine increasing and the ascites and dropsy disappearing. The digitalis was continued till November the 9th, when he had taken 15 drachms. On November the 7th his pulse became slower and irregular as a result of partial heart-block, the auricular contractions being unaffected. He vomited on November the 7th and 9th and the drug was stopped on the latter date. The patient's general condition was much improved and he felt brighter and better, though the heart's rate and size were not much affected. During this period his temperature was always slightly raised. After a week's cessation of the digitalis it seemed as if the heart was increasing in size, so he was again put on tincture of digitalis, 20 minims three times a day, and this was continued till the 24th when he had had 9 drachms. On the 21st his radial pulse rate fell to 100 and became irregular, owing to partial heart-block; an examination of the jugular tracing showed no change in the auricular rate and rhythm (Fig. 38 and 39). There were also occasional extrasystoles and the pulsus alternans (Fig. 40). Early in the morning of the 25th he vomited and the drug was stopped. From this date he continued to feel very well and comfortable, though there was only a slight improvement in the heart's condition. The liver dulness varied much from time to time without any coincident change in the heart. (See Chart, Fig. 41).

(For an analysis of the heart irregularities and the effect of atropin, see pages 292 and 297).

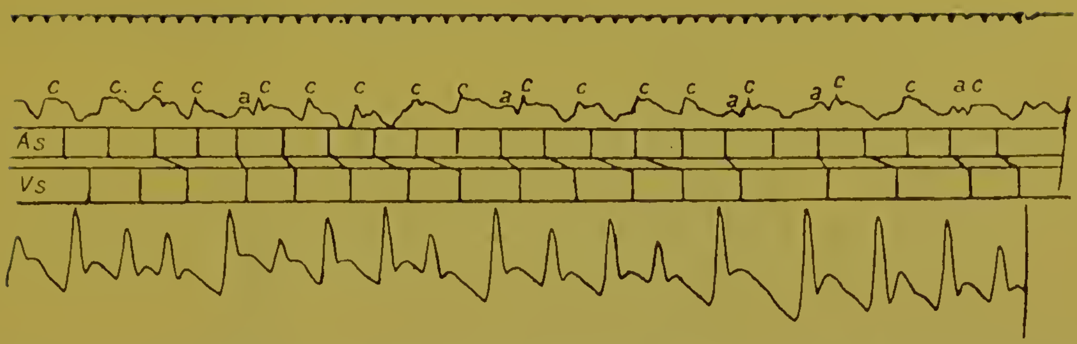

Fig. 38. Shows the irregular pulse produced by digitalis. The tracing from the neck is a mixture of the jugular and carotid pulses, and most of the auricular waves *a* are not distinct. The intercalated diagram explains the relation of auricular to ventricular rhythm, and shows that the irregularity of the radial pulse is due to partial heart-block (see Fig. 52 *CASE 27*).

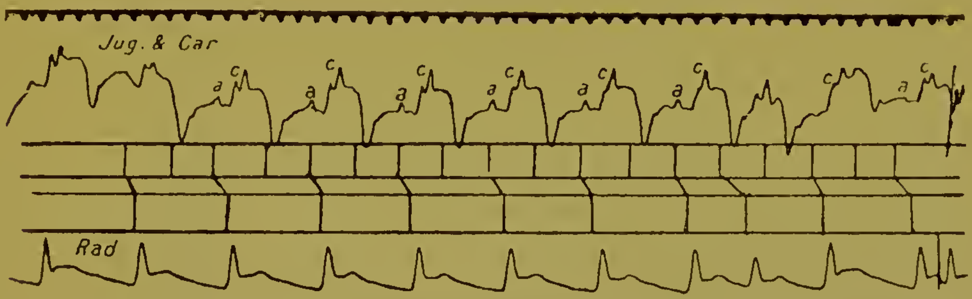

Fig. 39. The tracing from the neck is a mixture of the jugular and carotid pulses, and every second auricular wave is not distinct. The intercalated diagram shows that there is one ventricular contraction to two auricular contractions. (2 : 1 rhythm, except in one instance, see Fig. 52, *CASE 27*).

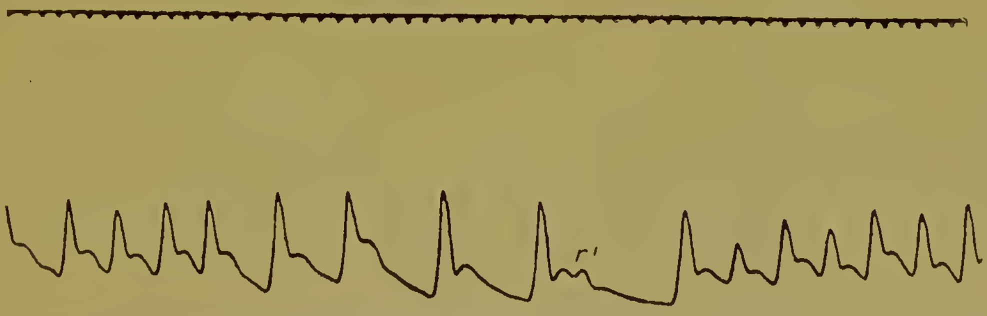

Fig. 40. Tracing of the radial pulse, showing an extrasystole r' followed by the *pulsus alternans*. The long pauses before the extrasystole are due to heart-block (*CASE 27*).

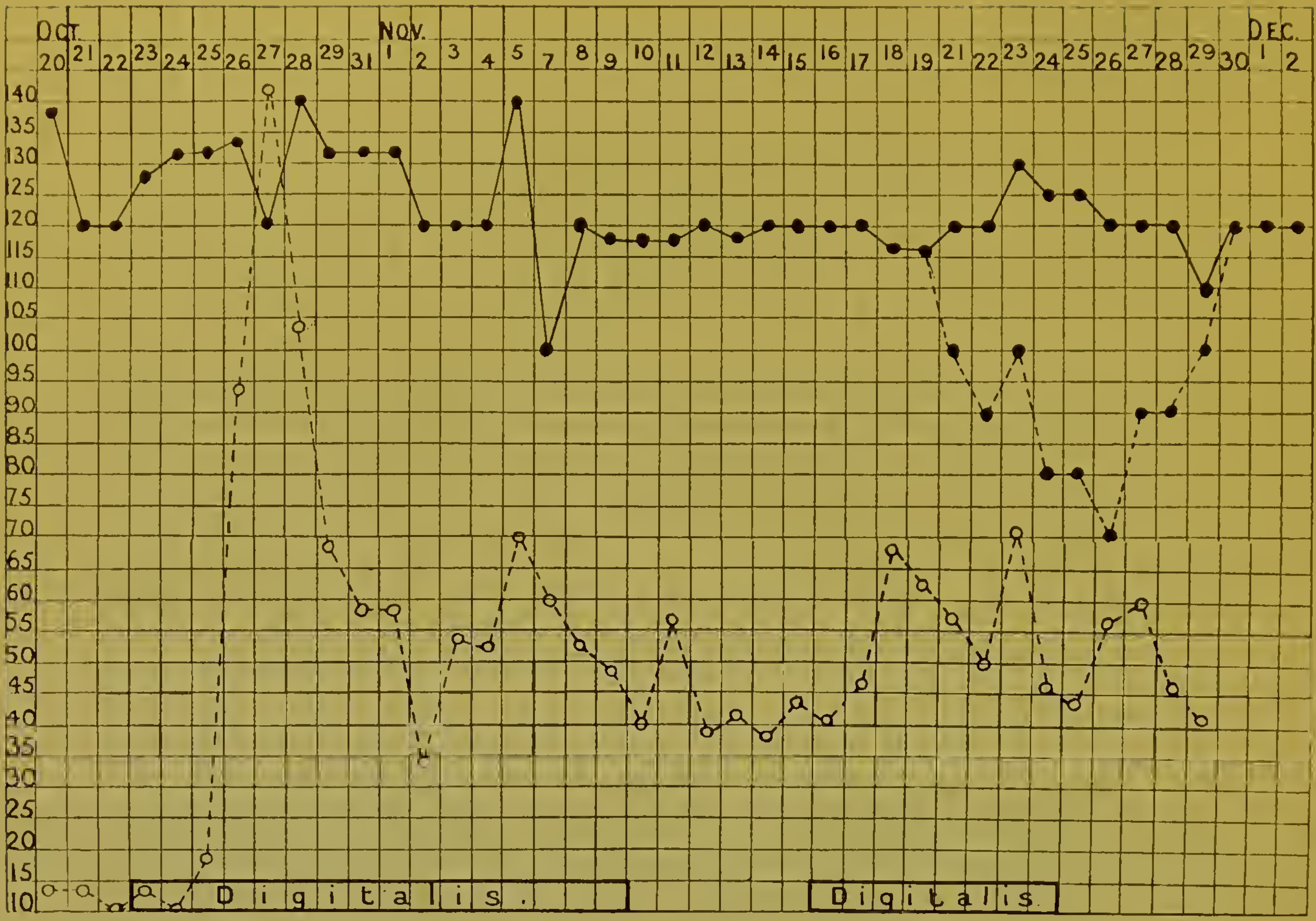

Fig. 41. Chart of *CASE 27.* The solid line represents the heart rate, but where the interrupted line occurs during a period of partial heart-block, the solid line represents the auricular rate and the interrupted line the ventricular rate. The interrupted line with circles represents the amount of urine.

Date.	Drug.	Pulse Rate.	Blood Pressure.	Size.	Urine.	Remarks.
Oct.						
20		138		2½-5¾	14	
21		120			14	Vomited and expectorated blood streaked phlegm.
22		120			10	Vomited several times. Feels much better to day. Coughing less, breathing easier.
23		128			14	Collapse.
24	Digit. ʒi p.d	132			5	Better. Still restless, has terrifying dreams. Vomiting.
25		132			19	No vomiting, feels easier.
26		134	120	1¼-5	94	Very much better, dyspnœa gone, can lie down and move about in bed quite comfortably.
27		120	132		141	Feels very well.
28		140	126		104	
29		132	120		68	
30					56	
31		132	130	1¼-4¾	58	
Nov.						
1		132	130		34	
2		120	132		54	Feels well, looks pale. Lungs clear.
3		120	120	1¼-5	53	Feels well.
4		120	114		70	Feels well.
5		140	130		60	Feels well.
7		100	130		53	Feels well, vomited twice to-day. Pulse irregular (partial block).
8		120	124		49	Feels well, pulse regular, no more vomiting.

DATE.	DRUG.	PULSE RATE.	BLOOD PRESSURE.	SIZE.	URINE.	REMARKS.
Nov.						
9	ʒxv Digit. stopped	118			57	Vomited twice this morning. Pulse irregular.
10		118	128		40	Feels well, no nausea, pulse regular.
11		118	118		44	Feels well, liver 3 inches below ribs.
12		120	128		34	Feels well.
13		118	116		42	
14		120	130		39	Feels well.
15		120	118	2¾-6¼	44	Feels well.
16	Digit.	120	118		42	Feels well.
17	ʒi p.d.	120	120		47	Feels well.
18		116	122	2-6	68	Slight headache last night.
19		116	118		63	No headache.
20		A120* V100	112	1¾-6	57	Feels well.
22		A120 V 90	120		50	Feels well, pulse irregular, partial block.
23		A130 V100	120		71	Feels well.
24	ʒix Digit. stopped	A125 V 80	134		46	Feels well.
25		A125 V 80	134	1½-5½	44	Vomited twice this morning.
26		A120 V 70	134		51	Feels very well.
27		A120 V 90				
28		A120 V 90	108	1½-5	60	Feels well.
29		A110 V100	120		64	Feels well.
30		A120 V120	130		46	Feels well.
Dec.						
1		120	126		41	Feels well.
2		120	114			

* A and V. The auricular and ventricular rates respectively, counted from the graphic records (see Chart, Fig. 41.)

CASE 28, male, aged 41. *Normal rhythm. Aortic disease. Rheumatic history. Digitalis caused diureses, and the raised blood pressure; it did not decrease in rate. Sudden death. Post-mortem.*

Chimney Sweep, admitted October the 16th, 1910, complaining of shortness of breath and swelling of legs.

History. The patient considered himself quite healthy until three months before admission when he had become short of breath on climbing stairs. This breathlessness gradually increased, and was so great that he could not walk about or lie flat in bed. Nine days before admission he noticed that his legs were swollen. He had micturated three or four times in the night for some years. He had had rheumatic fever three times, in 1891, 1893 and 1901. He was a soldier for thirteen years.

State on admission. The patient lay propped up in bed, looking very ill, the breathing was laboured at a rate of 32 per minute. The face was dusky and the lips cyanosed; there was a slight jaundiced tinge of the conjunctivæ. There was some swelling of the legs, and a good deal of oedema of the back over the sacrum. The tongue was covered with a thick fur. The radial pulse was large, regular and slightly collapsing. The arterial wall was thick and somewhat tortuous. The jugular veins were very full and pulsated. The heart's impulse was diffuse and the apex beat was in the sixth interspace and two inches outside the nipple line. The heart's dulness lay ¾ and 8½ inches to right and left of the mid-sternal line. At the apex there was a systolic murmur, heard also in the axilla. At the base there was a double murmur, systolic and diastolic in time, and heard loudest in the aortic area. The urine contained a faint trace of albumen (sometimes absent) and no sugar.

Treatment and progress. The patient was maintained at rest and his bowels were kept open by a rhubarb mixture and an occasional dose of calomel. He had no appetite and vomited several times during the first few days after admission. The temperature showed a slight rise. After this there was a little improvement, his breathing was not so distressed but he still had to be propped up in bed and the oedema persisted. On the 18th of October he was put on tincture of digitalis, 20 minims three times a day, and this was continued till the 25th when he vomited and it was at once stopped. He had taken 7 drachms altogether. After he had taken between three and four drachms he felt much better, could breathe more easily and lie flat in bed, while the flow of urine increased, the oedema disappeared and the jugular distension and pulsation were no longer visible. There was a rise in the blood pressure. On the morning of the 26th October, he suddenly died (see Chart, Fig. 42).

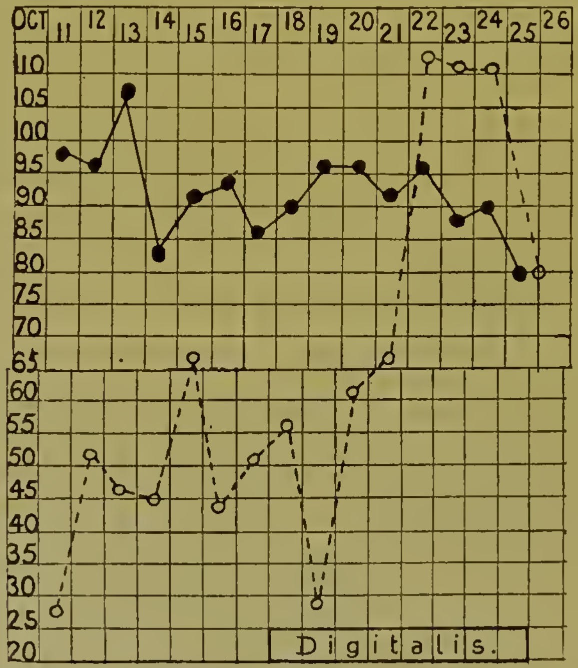

Fig. 42. Chart of *CASE 28*. The solid line represents the pulse rate and the interrupted line the amount of urine.

The heart was removed. Professor Woodhead's report accompanies these notes.

DATE.	DRUG.	PULSE RATE.	BLOOD PRESSURE.	URINE.	REMARKS.
Oct.					
11		98	170	28	Orthopnœa and cyanosis.
12		96	180	52	Very breathless, vomited.
13		108		47	
14		84	180	45	
15		92		67	
16		94		44	
17		86	174	51	Attack of bad breathing in the night.
18	Tr. Digit. ʒi p.d.	90	174	56	Distressed breathing in the night.
19		96		29	Feels better.
20		96		61	
21		92		66	Feels much better. Cyanosis gone.
22		96		133	
23		88		112	Dropsy gone.
24		90	198	120	Feels very well, able to lie flat.
25	ʒvii Digit. stopped	80	198	80	Vomited, feels ill.
26					Died suddenly.

Post-mortem notes.

The *heart* weighed 24 oz. Much enlarged ; milk spot on front of apex of left ventricle three-quarters of an inch from apex and extending 1 inch upwards ; thinner milk spot on right anterior surface of right ventricle. An old adhesion between the auricular appendix and the upper border of right ventricle, midway between extreme margin and interventricular groove, just above the auriculo-ventricular groove. Some slight thickening of front of auricle and appendix ; the same in front of left auricular appendix. Some old adhesions between auricle and ventricle, extending over left outer margin of auricle down to *A- V* groove, where the large lateral artery and vein run in the external left ventricular groove. A large colourless clot in the right auricle, ante-mortem in body of auricle but not in appendix. Wall of left ventricle greatly hypertrophied ; the greatest thickness seven-eighths inch, three-eighths at apex and a quarter inch at base. Musculi papillares and heart muscle of wall slightly mottled, fatty and somewhat pale. Right ventricular wall also hypertrophied, one-eighth to three-eighths inch thick ; some mottling. Both auricles dilated. Pectination of muscles well-marked in right auricle. *Pars membranacea* well marked between the auricles ; remains of valve but no opening. The endocardium in left auricle very considerably thickened, much wrinkling. *Striae* under endocardium well marked. Aorta shows well-marked atheroma, but not of very long standing, and with little calcification ; slight thickening of margins of cusps of aorta but valves fairly competent. A somewhat enlarged sinus immediately above the valve, especially where the coronary arteries come off. Some thickening of mitral valves in their bases, but the flaps of the cusps, where attached to the *chordae tendineae*, fairly normal ; some fatty degeneration at the base of anterior cusp. Tricuspid valve fairly normal, but a little thickening at base with some patches of fatty degeneration. Pulmonary artery somewhat thickened, especially endocardium.

Considerable amount of fat along *A- V* groove and especially in front and to the right of the right *a-v* surface, extending right away down to apex.

Piece of aorta : advanced atheroma, but no great calcification. Some contraction.

Liver : fatty, with slight central venous congestion.

Spleen : some congestion, probably chronic, firm, hard ; somewhat congested, probably slight increase of fibrous tissue.

CASE 29, female, aged 20. Aortic and mitral disease. Normal rhythm. Digitalis had no effect on the heart rate or blood pressure.

Admitted June the 30th, 1910, complaining of pain in left chest and shortness of breath.

History. The patient had had several attacks of rheumatic fever. Her first attack was at 15 years. The last attack was in February 1910. Shortness of breath had always been easily induced from her fifteenth year.

State on admission. The patient was a spare, nervous girl, who lay propped up in bed. The pulse was regular but collapsing ; its rate was 96 beats per minute. The apex beat was large and diffuse in the sixth interspace. The heart's dulness lay 1¾ and 6 inches to right and left of sternum. At the apex there was a rough systolic murmur. At the aortic area there were systolic and diastolic murmurs, the latter propagated down the sternum.

Treatment and progress. The patient was kept at rest for a week, after which she was given tincture of aconite for two weeks, but it had no effect upon her. She was put on tincture of digitalis, 15 minims four times daily, on June the 18th, and this was continued till the 24th, when she had taken 5 drachms. On this date she had a headache and vomited. Neither the pulse rate nor the blood pressure was affected. On the 25th she felt very well, in fact better than upon any day since she had been in the hospital. She was kept at rest after this, but as she did not improve, she was put on aconite on July the 4th and this was carefully pushed, but with no effect on the heart, save perhaps to accelerate its rate. On September the 7th she was again put on tincture of digitalis, 15 minims thrice daily, and this was continued for ten days. On the 14th and two following days she had headache and vomiting, and the drug was stopped on the 17th; from that date she was free from vomiting and also felt much better. Neither the heart rate nor the blood pressure was appreciably affected, but her general condition was slightly improved when she was discharged on September the 22nd (see Chart, Fig. 43).

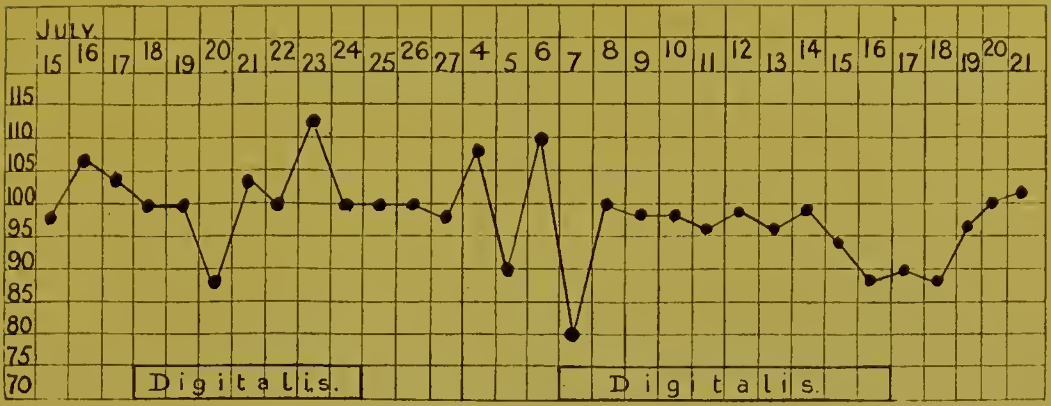

Fig. 43. Chart of *CASE 29.*

Date.	Drug.	Pulse Rate.	Blood Pressure.	Urine.	Remarks.
July.					
15		98	144	10	
16		106		21	
17		104		30	
18	Digit. ʒi p.d.	100	154	34	
19		100		19	
20		88		22	
21		104		29	
22		100		24	
23		112		27	
24	ʒv Digit. stopped	100		24	Vomited, headache.
25		100	142	18	
26		100			
27		98		16	
Sept.					
4		108	140	34	
5		90		20	
6		110	130	40	
7	Digit.	80		40	
8	45 m. p.d.	100	134	36	
9		98		40	
10		98		35	
11		96		40	
12		98	120	32	
13		96		22	
14		99		23	Vomited.
15		94		28	Vomited and headache.
16		88	138	24	Vomited and headache.
17	ʒvi¾ Digit. stopped	90		20	Better.
18		88		20	
19		96		40	
20		100		36	
21		102	144	30	
22		104			

CASE 30, female, aged 61. Normal rhythm. Aortic disease. Frequent ventricular extrasystoles. Emphysema. Digitalis and squills had no perceptible effect upon the heart.

Admitted April the 20th, 1910, complaining of weakness, shortness of breath and attacks of breathlessness and suffocation after exertion. Also a good deal of pain in the left chest at times.

History. The patient enjoyed very good health till two years before admission, when she seemed to age rapidly and became weak and short of breath. The legs had swollen at the end of a day's work, and she had to get up several times in the night to micturate. She was married and had had eight children. Her work had been heavy during the later years.

State on admission. She looked thin and pale, lay quietly and comfortable in bed but was breathless on exertion. The pulse was regular, save for the presence of frequent ventricular extrasystoles. The chest was somewhat emphysematous and the heart's dulness could not be mapped out accurately. The sounds were clear and the aortic second was slightly accentuated. The blood pressure was 142 mm. Hg..

Treatment and progress. As it was manifest that the patient was thoroughly exhausted, she was at first treated simply by rest. She gradually regained a good deal of strength, and many of her more distressing symptoms disappeared before she was discharged on July the 12th. As the extrasystoles persisted, we tried to see if digitalis would affect them, but although it was pushed till she vomited, it had no effect upon their frequency. Bromide of ammonium was also given, 80 grains per day for three weeks, but it had no effect on the extrasystoles. She was put on tincture of squills, 20 minims three times a day, on June the 20th, and this was continued till July the 11th, but it had no effect upon the extrasystoles, unless it caused them to occur more frequently. Towards the end of her stay in the hospital, a faint systolic murmur could be detected in the aortic area.

Date.	Drug.	Pulse Rate.	Blood Pressure.	Urine.	Remarks.
April 28		96	142	42	Cough, sense of suffocation at night.
May 2		84		44	Feeling better, scarcely any sense of suffocation.
8		70		61	Better.
9				30	
13		84		53	
18				38	
19	Tr. Digit. ʒi p.d.			56	
23		84		38	Feeling much better in every way. No cough.
24		78		40	
25		72		52	
26		80		43	
27	ʒiv¾ Digit. stopped	72		58	Not feeling well. Occipital and parietal headache. Sleeping poorly. Nausea.
28		74		25	Vomited.
29		82		16	Feels wretched. Been vomiting. Headache.
30		84	134	18	Feeling better but still nauseated.
June. 1		88	138	34	Feeling much better.
2		84		38	
4		80		47	
5		88		42	
15		100	146	38	

Date.	Drug.	Pulse Rate.	Blood Pressure.	Urine.	Remarks.
June					
16		100	132	56	
17				58	
20	Squills	100	144	22	
21		86		34	
22		100	154	35	
24		102		29	Feeling better.
30		92	134	29	
July					
2		90		28	
4		98		59	
7		96		47	
11	ʒxxi Squills stopped	84	144	39½	Feels well.

CASE 31, female, aged 46. *Normal rhythm. Mitral and aortic disease Rheumatic history. Digitalis produced vomiting, but had practically no effect upon the heart, and seemed to lower the blood pressure.*

Married, admitted December the 1st, 1909, complaining of cough and shortness of breath. Pain and tightness across the chest.

History. The patient was married and had had eight children. She had suffered from rheumatism each winter from the time of her youth, but there was no definite history of an attack of rheumatic fever. Four months previous to admission she began to suffer from shortness of breath and pain across the chest on exertion; her legs had swollen. She suffered also from attacks of palpitation even when lying quiet.

State on admission. The patient was a big, fat and florid woman. She preferred to be in bed and propped up. The pulse was regular. The apex of the heart was 1½ inches outside the nipple line in the sixth interspace. At the apex a systolic murmur was heard. At the base a systolic murmur, conducted along the carotid, and a soft diastolic murmur, conducted down the sternum, were present.

Treatment and progress. The patient was kept in bed for most of the three weeks after admission; she improved slightly and the swelling of the legs disappeared. On December the 12th she was put on tincture of digitalis, 15 minims four times a day, and this was continued till January the 1st, 1910, when she had taken 8¼ drachms. She continued to improve, though the pulse and blood pressure were unaffected. She had headache and was nauseated on January the 1st. A pulse rate of 54 and one of 100 was noted on this date and the drug was stopped. The headache passed off in a couple of days and she felt much better, and was discharged on January the 14th (see Chart, Fig. 44).

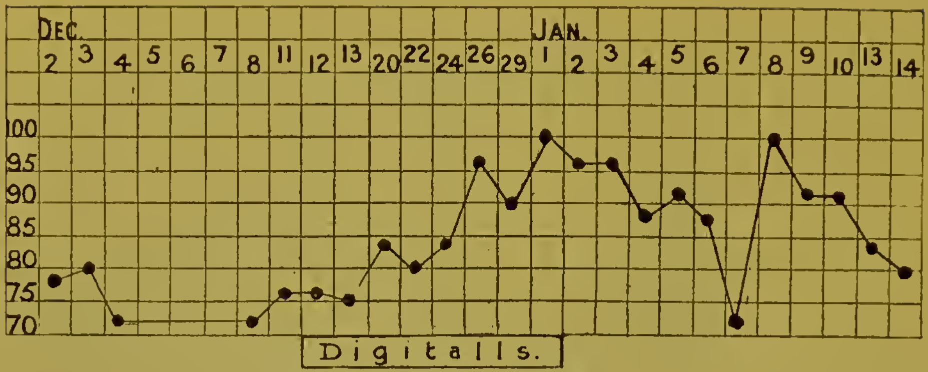

Fig. 44. Chart of *CASE 31*.

Date.	Drug.	Pulse Rate.	Blood Pressure.	Size.	Urine.	Remarks.
Dec.						
2		78				
3		80	140		9½	
4		72	126		23	
5					29	
6					30	
7					36	
8		72	140		64	Feels better.
11		76	136	¾-6	35	Feels very well, no pain now.
12	Tinct. Digit.	76			36	
13	ʒi p.d.	75		1-5½	30	Feels very well. Giddy after walking up flight of stairs.
20		84	120			Feels quite well.
22		80	126		16	
24		84	124		60	
25		96	114	1-5½	55	Feels very well. No pain.
26		96	114			No cough.
29		90	114	1-5½	55	Feels very well, sleeps well.
Jan.						
1	ʒxviii¾ Digit. stepped	54-100			12	Not feeling quite so well. Headache, slight nausea.
2		96			21	
3		96	112		57	Feels quite well again.
4		88			58	No headache.
5		92			54	
6		88			21	
7		72			51	
8		100			32	
9		92			40	Feeling well.
10		92			40	
13		84	110		36	
14		80	118		30	Feels very well in every way.

CASE 32, male, aged 18. *Normal rhythm. Mitral and aortic disease. digitalis was without effect upon the heart. Died. P.M. report.*

Admitted March the 8th, 1910, complaining of weakness, breathlessness on exertion, and pain in breathing.

History. The patient had had several attacks of rheumatic fever five years before admission and had never been very strong. He had been working with a blacksmith and swinging a 7 lb. hammer up till five weeks before admission. He had had to stop work as he was very short of breath, attacks of dyspnoea coming on suddenly and lasting from 10-20 minutes.

State on admission. The patient was a frail and delicate looking boy, but bright and intelligent. He lay propped up in bed, the face slightly flushed. The pulse was regular; its rate was 88 per minute. The apex beat was in the sixth interspace, one inch outside the nipple line. The heart's dulness lay 1 and 4 inches to right and left of the mid-sternal line. At the aortic area there were well marked systolic and diastolic murmurs; they were heard also all over the heart. At the mitral area there was a systolic murmur of a different character, and it was propogated into the axilla. There was marked capillary pulsation after rubbing the skin of the forehead. The liver was large, extending three inches beyond the ribs and pulsating. A tracing of the pulsation showed it to be of the auricular form. There was no swelling of the legs. The urine was free from albumen.

Treatment and progress. The patient was at first treated by rest alone and for a while he seemed to improve, but as time went on his temperature began to rise at irregular intervals. In the middle of April his temperature rose steadily for a week to 103 Fahr., during which time he was very ill. It suddenly fell, and his condition improved. Various remedies were tried with little or no beneficial effect and he died on June the 6th, with symptoms of extreme heart failure. Digitalis was given on two occasions, once in April when it had to be stopped as the patient was suffering much from obscure pains in his shoulder joint. It was again tried in May and, although pushed until he was sick, it had no effect upon the pulse rate. During this time the temperature rose a little above the normal. It will be observed that the blood pressure rose as his heart was failing (see Chart, Fig. 45).

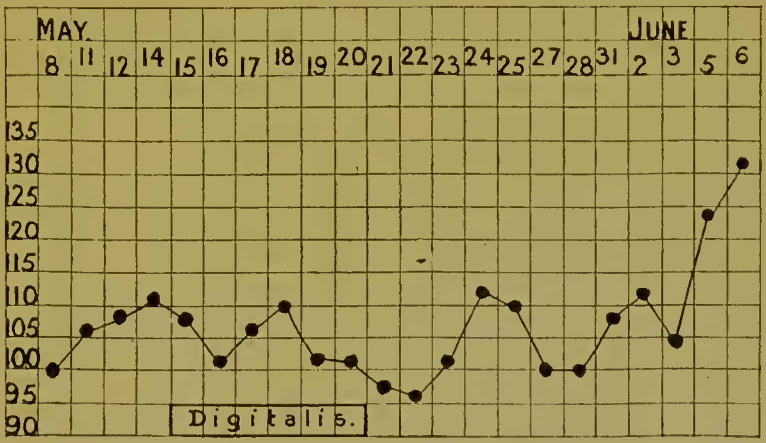

Fig. 45. Chart of *CASE 32.*

Date.	Drug.	Pulse Rate.	Blood Pressure.	Remarks.
May				
8		100	104	
11		106		Feels very ill, distressed breathing.
12		108		Same.
14		112		Feels better, hallucinations. Crepitations at both bases.
15	Digit. ʒi p.d.	108	128	Feels ill.

DATE	DRUG.	PULSE RATE.	BLOOD PRESSURE.	REMARKS.
May				
16		102		Feels ill, breathing distressed.
17		106		
18		110		
19		102		Feels much better, nausea.
20	ʒv Digit. stopped	102		Vomited. Liver one inch below ribs.
21		98		Feels better but very short of breath.
22		96		Base of right lung dull and crepitations.
23		102		Very ill, restless and sleepless.
24		112	126	Very ill, pallid. Liver 1½ inch below ribs.
25		110		Vomited, never slept. Very ill.
27		100		Slightly better.
28		100		Much better. Liver 3 inches below ribs.
31		108	124	
June				
2		112	136	Very ill, dulness at both bases.
3		104	130	
5		124	134	
6		132		Died.

Professor Woodhead's report of the post-mortem examination.

Weight of heart with adherent pericardium, 1 lb. 10½ oz., without pericardium, 1 lb. 2 oz.

Length of cavity of left ventricle 8·5 cm.; thickness of wall 1·5 cm. down to 0·5 cm. at apex. Some thickening of apices of musculi papillares. Adhesion of mitral valve at free margins. Small vegetations at lower portion of somewhat funnel-shaped orifice; cusps contracted and thickened. *Chordae tendineae* opaque and perhaps slightly contracted. Aortic orifice somewhat narrowed, cusps thickened, contracted, slightly granular, small vegetations along thickened margins; no atheroma of aorta. Coronary arteries slightly thickened and narrowed.

Right ventricle: length of cavity 6·0 cm., thickness of wall 0·4–0·15 cm., somewhat dilated, muscles slightly mottled. Pulmonary cusps normal, tricuspid valve normal, perhaps some thickening and opacity of musculi papillares. Right auricle dilated, coronary vein very wide, some thickening of endocardium, especially at base of tricuspid valve.

Old adhesions on the outer side of upper half of the left ventricle coming forward somewhat to the front. Adhesions over aorta and pulmonary artery. Left ventricle greatly distended and filled with clot. Right ventricle contains a smaller clot. Clot in both pulmonary veins. Large amount of mucus in the bronchus on both sides; a gelatinous mucus almost like fibrin.

CASE 33, female, aged 46. *Normal rhythm. Aortic and mitral disease. Digitalis and squills had no apparent effect on the heart.*

Admitted January the 26th, 1910, complaining of shortness of breath and cough.

History. The patient had had a winter cough for many years. Four years ago her legs had swollen, but there had been no swelling during the two years prior to admission. Palpitation had been present during exertion and paroxysms of coughing.

State on admission. The face was pale and rather pinched, the lips were dark. She was well nourished. The chest was barrel-shaped and hyper-resonant. The apex beat was in sixth interspace and outside the nipple line. The heart's dulness lay 1½ and 5 inches to the right and left of the mid-sternal line. The pulse was anacrotic and regular, save for the occurrence of an occasional extrasystole. At the apex the first sound was loud and slapping and preceded by a short murmur; the second sound was followed by a faint diastolic murmur. At the aortic area there was a soft blowing systolic murmur, heard also in the carotids, and a diastolic murmur.

Treatment and progress. The patient was kept at rest in bed for the first five days after admission. On February the 2nd, she was put on tincture of digitalis, 15 minims four times a day, and this was continued till the 6th when she had taken 4½ drachms. On that date she felt sick, vomited and had a severe headache. No change in the heart's action was detected. After the vomiting passed off she felt much better and could undertake exertion with much less distress in breathing. This breathlessness after exercise gradually returned, and on February the 16th she was put on tincture of squills, 15 minims four times a day, and this was continued for ten days; it was stopped after she had taken 11 drachms, because she was having severe headache. She was discharged on the 27th, on the whole a little better, in so far as she could undertake exercise with less discomfort than when she came into the hospital. The squills did not seem to modify the heart's action.

Date.	Drug.	Pulse Rate.	Blood Pressure.	Size.	Urine.	Remarks.
Jan.						
26		90		1½-5½		Short of breath, cough troublesome.
31		82	116		36	Better, cough less.
Feb.						
1		90			30	Feels heart beating unpleasantly.
2	Tr. Digit.	84			40	Not feeling heart to-day.
3	ʒi p.d.	78	122	¾-4½	25	Not feeling heart, less dyspnœa after exercise.
4					44	Feels very well.
5					25	
6	ʒivss Digit. stopped	80		½-4½	21	Has vomited three times. Severe frontal headache.
7		82	114		34	Headache gone, no nausea (slight this morning), can lie in any position, no discomfort.
8		87			24	Feels well, no cough, markedly less dyspnœa after exercise.
9		92	108		57	Sleeps well. No dyspnœa after exercise.
10		90			52	
11		82			50	Feels very well.
12		80			30	
14		80			51	Complains of tightness in chest, slight cough.
15					43	
16	Tr. Scillae	88	107	1½-4½	58	Cough less, more breathless after exercise
17	ʒi p.d.	86	120		36	Better, pain and tightness gone. Some dyspnœa after exercise.

DATE. Feb.	DRUG.	PULSE RATE.	BLOOD PRESSURE.	SIZE.	URINE.	REMARKS.
18		72			44	Feels well.
19		88			38	Fairly well.
21		82			49	Feels well.
23		78	135	1-5	40	Some headache, some dyspnœa after exercise.
25		92			50	Headache.
26	ʒxi Scill. stopped	88			48	Headache. Dyspnœa after exercise.

CASE 34, female, aged 54. Normal rhythm. Mitral and aortic disease. Extrasystoles. Digitalis caused vomiting. Slight improvement in the general condition, but no appreciable effect on the heart.

Admitted March the 16th, 1910, complaining of great shortness of breath, a suffocating feeling, at times over the throat and chest, and occasional attacks of dizziness and partial loss of consciousness.

History. The patient had been weakly for 30 years, and became worse 17 years before admission when she began to have attacks of semi-unconsciousness. When these came on she felt as if everything was going round, and she would have fallen if she had not held on to a support. She could hear what was going on but was unable to speak. She could usually tell when the attacks were coming and had time to sit down. The attacks usually lasted about two minutes, and they used to come on about once in every six or ten days, but of late years they had been less frequent. Any form of exertion produced shortness of breath and palpitation very readily. She was married at the age of 15, and had had eleven children. There was no history of rheumatism.

State on admission. She looked old and careworn, but could lie in any position without discomfort. The lungs were emphysematous. The pulse was regular except for the occasional occurrence of an auricular extrasystole. The blood pressure was 125 mm. Hg.. The heart's dulness lay 0 and 5 inches to right and left of the mid-sternal line. At the apex there was a long presystolic murmur running up to and terminating in the first sound. The second sound was followed by a short soft murmur. At the aortic area a short systolic murmur and also a diastolic murmur were heard. The Sp. Gr. of the urine was 1020 ; there was no albumen.

Treatment and progress. The patient was kept at rest in bed, and during this period she felt quite comfortable, but was very short of breath on exertion (going up a flight of stairs). On March the 30th she was put on tincture of digitalis, 15 minims four times a day, and this was continued till April the 4th, when she had taken altogether 4¼ drachms. She vomited after the last two doses. While taking the digitalis she showed some improvement, being able to undertake further effort without distress ; the drug was stopped because of the vomiting. There was no perceptible effect upon the heart. After the vomiting ceased she felt better on the whole and when discharged from the hospital on April the 17th her general condition had improved; this was evidenced by her response to effort. Auricular extrasystoles occurred occasionally during the time she was taking the digitalis.

DATE.	DRUG.	PULSE RATE.	RESP.	BLOOD PRES.	SIZE.	URINE.	REMARKS.
March							
18		78	22	125	-5	48	Feels quite comfortable.
21		82	24	110	¾-5	66	Feels well, dyspnœa only after exercise.
22		90	24	98		40	Feels quite well, sleeps poorly.
23		80	22			56	
24		86	20	96	½-5	76	Feels quite well, no pain.
27		72				58	
30	Tr. Digit. ʒi p.d.	98	24	100	½-4½	82	Some oppression in chest past two days, otherwise well. Sleeping better.
31		78	20	110		46	Very slight pain in chest.
April							
1		80				46	
2		74	20	108		40	Not feeling quite so well, sick faint. Less appetite.
3		76				20	
4	ʒivss Digit. stopped	80	16	104	½-4	25	Vomited last night and to-day feels sick and giddy. Slept better.
5		84				30	Feels better.
6		76	18	106		32	Severe headache, otherwise feels fairly well.
7		72				20	Feels quite well.
11		76	22			60	Feels quite well. Only slightly short of breath on exercise.
14		80		104		64	Feels very well, only slightly short of breath after walking upstairs.

CASE 35, male, aged 39. Normal rhythm. Mitral and aortic disease. Digitalis had no apparent effect on the heart.

Electrician, admitted October the 11th, 1910, complaining of attacks of palpitation and pain in left shoulder and chest.

History. The patient had had scarlet fever and measles in childhood. Nine years ago he had an attack of rheumatic fever. He suffered for many years from influenza, having had an attack each winter. Three years ago and after an attack of influenza, he became short of breath after exertion, and this continued more or less until admission. Two years before this he began to have pain as well as shortness of breath after exertion, the pain being felt over the left chest below the nipple. Latterly the pain has extended from this region up to the left shoulder and occasionally it has extended down the inner side of the arm to the ulnar side of the forearm and to the fingers. The heart thumped and seemed to stop and cause a choking sensation at times.

State on admission. The patient lay flat in bed; he was pale but fairly well nourished. The pulse was small and regular; its rate was 76 per minute. The heart's dulness was increased and lay 5½ inches to the left of the mid-sternal line. At the apex there was a blowing systolic murmur which was transmitted to the axilla. At the aortic area, there was a faint systolic murmur, transmitted into the carotid.

Treatment and progress. The patient was kept at rest, mostly in bed, and he gradually regained strength, sometimes feeling very well, at other times suffering from pain in the left chest. On October the 18th he was given tincture of digitalis, 15 minims three times a day, and on October the 25th this was increased to four daily doses and continued till the 26th, when he had taken altogether 7 drachms. He was sick on the 25th and vomited on the 26th, but there was no appreciable effect on the heart. The sickness disappeared and the patient continued much as before the drug was taken, some days feeling well, on other days not so well, until his discharge on November the 5th.

DATE.	DRUG.	PULSE RATE.	BLOOD PRESSURE.	URINE.	REMARKS.
Oct.					
11		76	110		
12				52	Pain below left clavicle in night.
14		72		64	Still pain below clavicle.
15		72		84	Feels well, no symptoms.
16				73	
17		74	110		Feels well.
18	Digit.	72		77	
19		72		72	Slight headache.
20		66		73	Slight headache.
21		70		76	Nose bleeding about five minutes.
22		75		63	Slight pain in precordium.
24		78		60	Slight pain still.
25		70		50	Feels sick, no vomiting, frontal headache.
26	ʒvii Digit. stopped	72	114	60	Feels worse, vomited this morning, frontal headache.
27		74	100	41	Slight headache, no vomiting, nausea.
28		74	118	44	Slight frontal headache, appetite returned
29		70	118	60	Same.
31		72	114	58	No headache, feels well.
Nov.					
1		74	112	66	Suffocating feeling during night.
2		78	110	60	Pain in left breast and down arm for 15 hours.
3		74	108	65	Feels well, no pain.

CASE 36, male, aged 13. Normal rhythm. Aortic and mitral disease. Rheumatic history. Digitalis given over a long period had no effect upon the heart, except for causing extrasystoles and exaggerating the sinus irregularity.

Admitted April the 26th, 1910, complaining of shortness of breath on exertion.

History. The patient had had slight attacks of "rheumatism" but was never laid up till March last, when he was in bed for a week with pain in his joints. He had been short of breath and weakly from this time until admission.

State on admission. Small, pale but healthy looking boy. He was quite comfortable while lying in bed. The pulse was regular ; its rate was 94 per minute. The heart's impulse was diffuse in the third, fourth and fifth interspaces. The heart's dulness lay 1½ and 4½ inches to right and left of mid-sternal line. At the apex a rough systolic murmur replacing the first sound, and a long murmur following the second sound were heard. The temperature was 99 degrees Fahr..

Treatment and progress. The patient felt no discomfort when at rest, but in view of his recent attack of rheumatism, it was deemed advisable to keep him quietly in bed. On June the 3rd, he was given 10 minims of tincture of digitalis three times a day. This was continued till the June the 28th, when he had taken 7 drachms of the tincture. There was no apparent effect till he had taken about 6 drachms, when he felt some nausea. On June the 6th he began to show ventricular extrasystoles (Fig. 46), when the heart became quiet after exertion. These could be induced up till the 16th after which date they ceased to appear. On June the 19th the quantity of digitalis was doubled and continued till the 29th, the only symptom shown being slight nausea and giddiness. Before he began the digitalis he showed sinus irregularity when the heart was slowing after exercise, and this continued and became exaggerated during the whole time he was under digitalis. The rate of the heart fluctuated, but it was never much affected by the digitalis. There were frequent slight rises in the temperature during the short time he was under observation.

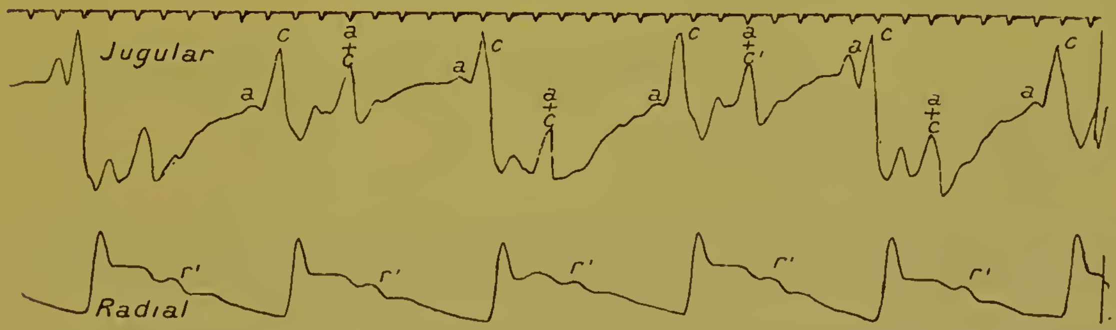

Fig. 46. Tracings from *CASE 36.* Every alternate beat (r′) is due to a ventricular extrasystole.

DATE.	DRUG.	PULSE RATE.	SIZE.	URINE.	REMARKS.
April.					
28		94	1½-4½	43	
May					
8		90	2-4	50	
10		80		42	
12		81		42	
16		84	1¼-3½	54	
24		78	1-3½	51	
27		80		64	
30		84		51	
June.					
2		76	¾-3⅜	58	
3	Digit. ʒss p.d.	84	¾-3½	65	
4				68	
5		72		58	
6		72		59	
8		72	1¼-4		
10		78	1-3¾		
12		69			
14		72			
16		81			
17		66			
19	ʒi p.d.	72			
23		66	1½-4½		Feels quite well except for slight nausea.
24		88			Some nausea.
27	ʒxv Digit. stepped	66	1½-4½		
July					
3		72			

CASE 37, male, age 47. Paroxysmal tachycardia, the tachycardia becoming continuous. Digitalis produced auricular fibrillation and eventually restored the normal rhythm.

Army officer, admitted May the 3rd, 1910, complaining of great prostration and consciousness of rapid and fluttering action of the heart which was very distressing at times.

History. The patient had been quite well and healthy until 1902. During the South African war he became conscious of occasional attacks of fluttering of the heart. These attacks did not cause much distress till 1905, when they became very frequent and ultimately continued for a few months. After a long rest, the heart became slow and regular in its action for a few years, but during the three or four months preceding admission the attacks had recurred with great frequency and severity, and during the last few weeks the heart had rarely ceased its rapid action and he had become so weak that he had been unable to walk or exert himself. There was no rheumatic or specific history.

State on admission. The patient lay in bed with his shoulders raised. His face was slightly livid and had an anxious expression. He was well nourished and otherwise healthy looking. His pulse was small, soft and regular except for occasional pauses ; its rate was 140. The blood pressure was 100 mm. Hg.. The heart's dulness lay 0 and 4¼ inches to right and left of the mid-sternal line. The sounds of the heart were like the tic-tac of the fœtal heart, and were free from murmurs. The patient was afraid to exert himself, fearing the heart would go off with a rapidity and violence such as frightened him.

Treatment and progress. The patient at first felt greatly exhausted, the heart persistently beating at a rate between 130 and 150 per minute, with occasional short periods of irregularity at a lower speed. For the first five or six weeks he had attacks during which the heart's rate became enormously increased. These were sometimes provoked by a very slight exertion, such as by standing up for a few moments or by having the bowels moved. A few of these attacks were observed, and the pulse rate graphically recorded, and a speed of between 290 and 300 beats per minute was attained, the highest rate of the human heart I have ever seen graphically recorded. It was utterly impossible to count the heart's rate either from the pulse or by auscultation of the heart. These attacks lasted for half an hour to an hour, and during this time the patient was in great distress. They grew less frequent, and finally disappeared after various remedies had been tried. The pulse rate still continued to be rapid, though it became irregular more frequently. The attacks of extreme rapidity occurred chiefly during the night when he was awakened by disagreeable dreams.

On June the 22nd he was put on ammonium bromide, 20 grains three times daily, and this was continued till July the 22nd. Shortly after beginning the medicine, his nights were more composed and the violent and rapid attacks gradually diminished, till after a couple of weeks they ceased entirely. On July the 22nd he was put on tincture of digitalis, 20 minims three times daily. At this time, his pulse rate was always between 140 and 150 beats per minute (Fig. 47 and 56), with occasional pauses. No effect was produced till the 27th, when 5 drachms of the tincture had been taken and he suffered from nausea. The pulse fell to 55 beats per minute and became continuously irregular (Fig. 48) with occasional paroxysms of rapid rate (140 per minute) lasting for a few seconds. The irregularity was characteristic

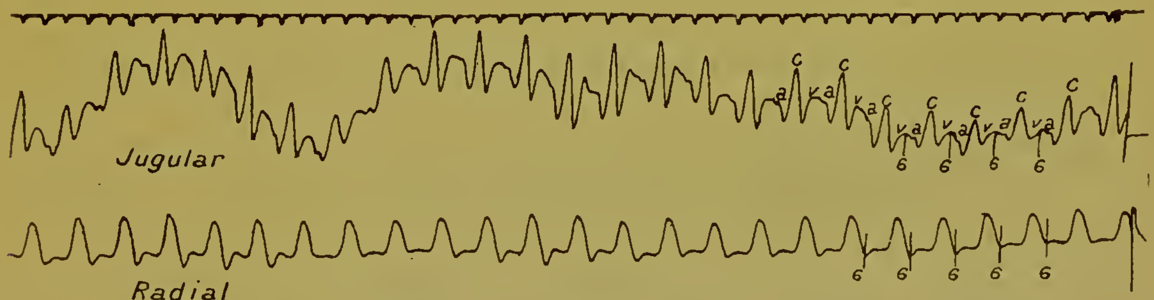

Fig. 47. Tracing of radial and jugular pulse during a period of continuous tachycardia. Rate, 140 beats per minute. The downstroke 6 indicates the time of the opening of the tricuspid valves. Following 6 in the jugular, in place of the fall that normally occurs, there is a small wave *a*, which is in all likelihood due to the auricle. (See electrocardiogram, Fig. 56, *CASE 37*).

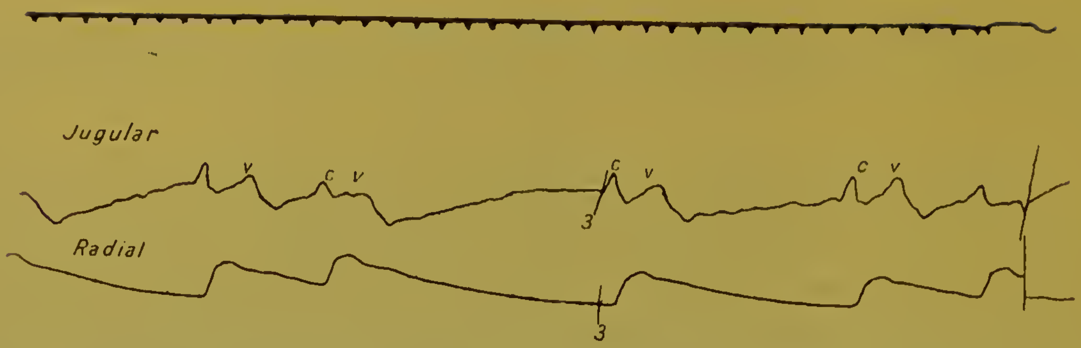

Fig. 48. Shows the irregular pulse due to auricular fibrillation. (*CASE 37* on July the 27th, 1910).

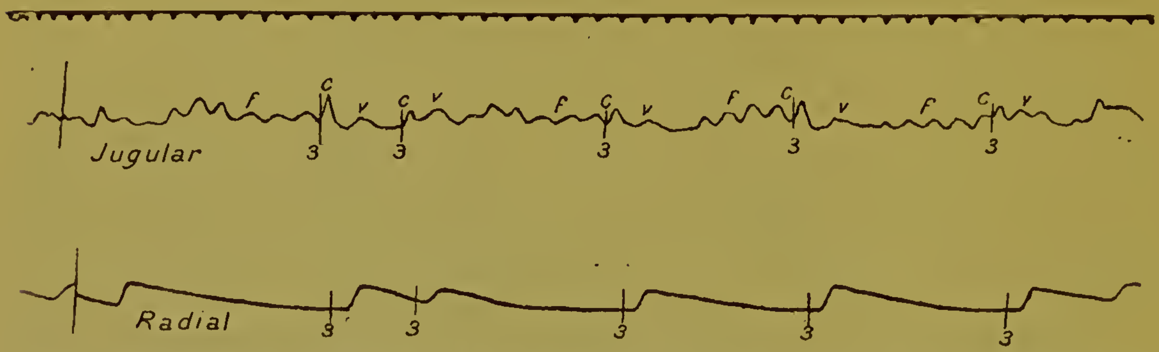

Fig. 49. Slow irregular pulse due to auricular fibrillation, showing the coarse auricular fibrillary waves *f* (compare with the fine waves in Fig. 21 (*CASE 11*). (*CASE 37* on July the 28th, 1910.)

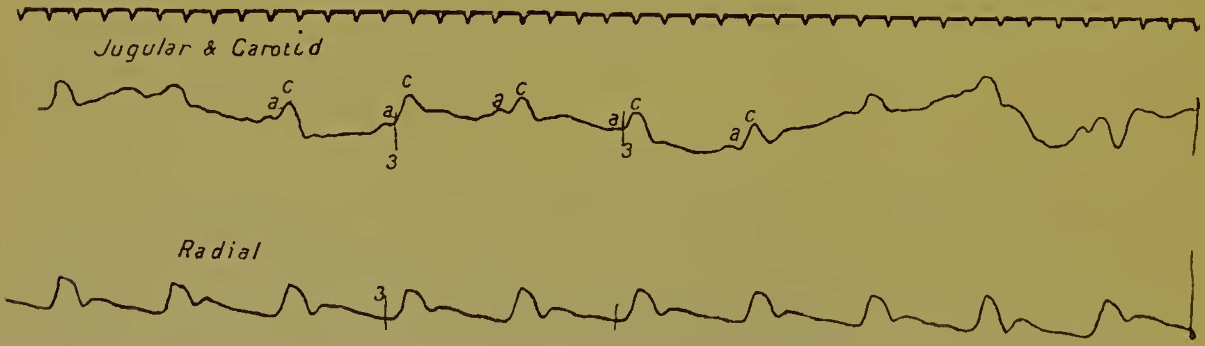

Fig. 50. Shows the normal rhythm occurring at intervals, during auricular fibrillation.

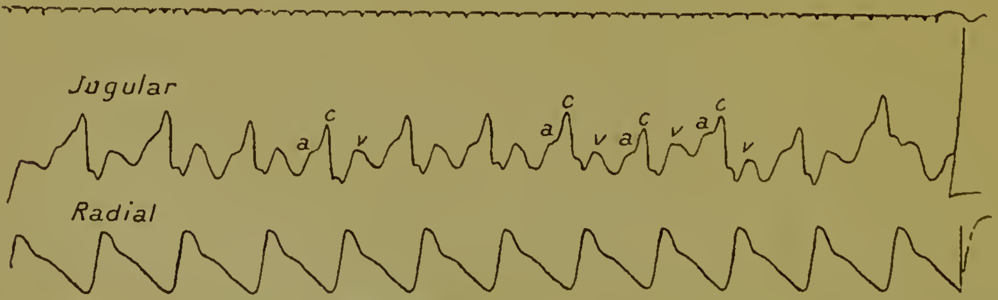

Fig. 51. Shows the normal rhythm when it becomes permanently restored.

of auricular fibrillation and the jugular tracing occasionally showed the fibrillary waves, when the rate was slow and irregular (Fig. 49). On the 28th, periods of regular rhythm at about 70 beats per minute varied with periods of fibrillation at about 50. The regular periods evidently belonged to the normal rhythm and an auricular wave *a* could be detected in the tracing in the neck before the carotid (Fig. 50). The digitalis was stopped on the 28th as the patient felt sick, but was resumed on the 30th and continued in half doses (½ drachm per day) till August the 7th. From August the 2nd to the 10th the heart beat slowly and irregularly at a rate of from 40-50 beats per minute, and the jugular tracings showed occasionally marked fibrillion waves (Fig. 49). From August the 17th to the 24th the heart's rhythm was very inconstant, showing periods of the normal rhythm, tachycardia and auricular fibrillation. After the 24th the periods of tachycardia became more frequent. On September the 4th the digitalis was resumed at first in 5 minims doses three times daily, on September the 17th it was increased to 10 minims, three times daily; he was kept on this quantity till October the 7th, when he was discharged. On September the 7th, three days after starting the digitalis, the attacks of tachycardia did not last so long, and from this date they gradually decreased till the 29th when the heart became quite steady and the rhythm normal (Fig. 50 and 51). In the tracings we could detect occasional auricular extrasystoles. After his discharge we kept in touch with the patient, who continued to take his digitalis (½ drachm per day). He gradually regained his strength and the attacks of tachycardia only recurred at rare intervals and for only a few minutes.

CASE 38, male, aged 74. Tachycardia of obscure form. Digitalis produced auricular fibrillation, and finally stopped the tachycardia.

Complaining of weakness and shortness of breath on the slightest exertion, and consciousness of rapid action of the heart.

History. He had been a healthy man up to the end of January 1910, when on waking one morning he felt ill in an indefinite way. He consulted Dr. Ford Anderson, who found his pulse to be beating very rapidly. He kept very quiet for a few days, but getting no better stayed in bed. In spite of treatment and rest his condition remained unaltered.

Condition on May the 10th. He was lying in bed quietly, his breathing easy, though as slight an effort as talking hurried his respirations, but he got up for three or four hours in the evening. The lips and nose were cyanosed. The pulse was rapid, 150 beats per minute, soft and regular, except for an occasional pause. The apex was not palpable and the dulness extended to the nipple line. The sounds were weak but clear. There were distinct pulsations of the jugular and a tracing showed them to be ventricular in form, though after an occasional pause there was an auricular wave preceding the time of the carotid.

Treatment and progress. On May the 16th he was put on tincture of digitalis, 20 minims three times a day, and this was continued till the 26th, when he had taken 8 drachms; on this date he suffered from nausea. The pulse rate had continued at 150 per minute till the 23rd, when it fell to between 80 and 90 per minute, the rhythm being irregular and of the kind characteristic of auricular fibrillation. On the 26th the rapid rate had again returned (150 per minute), but it was occasionally interrupted by pauses when there would be two or three beats at a slower rate, and an auricular wave was then perceptible in the jugular tracing. On the 25th the pulse was at 150 beats per minute. On the 27th the pulse was regular at 78 per minute, and the jugular tracing showed a well marked auricular wave. The rate on this day was interrupted by a break back into a long paroxysm, lasting two minutes, the rate being 150 per minute. On this day digitalis was resumed, in 10 minim doses three times a day, but was stopped on the 30th as nausea reappeared. The pulse remained at the rapid rate of 150 per minute. Aconite was then tried, but, though various preparations of the tincture were used, they were without effect. In the early part of July the patient was steadily getting worse, the breathing was difficult and attacks of dyspnœa came on from no apparent cause. On July the 8th a second course of digitalis was commenced, one of Nativelle's granules being given three times a day. At this time the pulse rate was 150 per minute and showed marked alternation. On the evening of July the 19th he complained of nausea and the digitalin was stopped after he had taken 33 granules. On the following day the pulse rate had fallen to 76 beats per minute, at times regular and at other periods irregular, as a result of occasional appearance of beats similar to those in the paroxysm. On July the 22nd he complained of feeling uncomfortable and ill; he was very breathless. He was queer in his head, his memory was bad, he was restless, talking a good deal and incoherently. On July the 24th the pulse was perfectly regular at 72 per minute; there was a well marked auricular wave in the jugular pulse at the normal instant. He was still feeling ill and the mental balance had not been quite regained. He knew that his mind was wandering; his memory was bad and his whole mental condition confused.

On July the 27th he expressed himself as feeling very well, better than he had been for a long while; the breathlessness had entirely disappeared and his mind was quite clear. The heart's rate was 72 per minute and the rhythm normal, with the exception of an occasional extrasystole. From this time onward he steadily improved; he went to the seaside where he was quite able to walk for three miles, mostly uphill, with no distress.

CASE 39, male, aged 76. Complete heart-block. Digitalis caused diuresis and disappearance of dropsy with no effect on the ventricular rate. Aphasic attack.

Admitted September the 2nd, 1910, complaining of shortness of breath and swelling of the legs.

History. The patient had had a weak heart for some years. For the three years prior to admission he had had occasional attacks of loss of consciousness. His pulse rate until June, 1910, was usually between 60 and 70 beats per minute, but during his attacks of loss of consciousness it fell as low as 14 per minute. In June he had a series of attacks, losing consciousness forty times in one day. After these attacks had subsided, his pulse rate remained slow, between 25 and 30 beats per minute, and he had no attacks from June till the date of examination. He had however suffered much from breathlessness and swelling of the legs.

State on admission. The patient was a pale thin man, walking about in a slow deliberate manner. When in bed he preferred to lie with his shoulders raised, but he could lie flat. He was not short of breath unless he exerted himself. The pulse was regular at 26 beats per minute. A tracing of the jugular pulse showed three auricular waves to one carotid. The heart was enlarged, the apex beat lay two inches outside the nipple line, and there was a rough systolic murmur, loudest at the apex. The legs were greatly swollen as high as the thighs. The urine was free from albumen.

Treatment and progress. He was treated by rest for a few days, but, showing no improvement, he was put on digitalin granules, one three times a day. He took granules for 5 days, when he became nauseated and felt ill and miserable. He passed large quantities of urine and the dropsy entirely disappeared. He stopped the digitalin and the following two days he was able to go about with greater freedom and felt extremely well, and could do more than he had done for many months. Notwithstanding this the pulse rate remained unaffected at about 30 beats per minute. On the third day after stopping the digitalin he was seized with a peculiar aphasic condition, in which he could neither speak coherently nor write intelligibly, though he seemed perfectly conscious. This passed off in a few hours and left no trace in his speech. After a few days the digitalin was resumed, one granule per day was given. When last heard of he was fairly well and the dropsy was being held in check.

CASE 40, male, aged 37. Normal rhythm. Emphysema. Digitalis had no effect upon the heart.

Admitted November the 29th, 1909, complaining of shortness of breath and cough.

History. The patient had suffered for years from shortness of breath and cough, but had been getting much worse before admission.

State on admission. The patient lay propped up in bed, the face slightly cyanosed. The breathing was laboured. The lungs were hyper-resonant; the chest was characteristically emphysematous. There were numerous moist râles and rhonchi over all parts of the lungs. The cough was very troublesome at times and he brought up a large quantity of white frothy sputum. The heart's dulness could not be made out satisfactorily. There was a rough systolic murmur at the mitral area. The pulse was regular, its rate was 84 beats per minute.

Treatment and progress. For six days the patient was given no drug, but was allowed to rest. On December the 5th he was put on tincture of digitalis, 15 minims four times daily. This was continued till the 11th when he had taken 6 drachms. The digitalis showed no effect on the heart's rate but on the 11th there was a good deal of vomiting and headache. There was little or no improvement in the patient's condition and no treatment gave him much relief. Sometimes when inhaling oxygen he felt better, but the improvement was only transient and he was discharged on January the 13th, 1910, only very slightly improved.

DATE.	DRUG.	PULSE RATE.	URINE.	REMARKS.
Nov.				
29		84	18	Cough and shortness of breath troublesome.
Dec.				
1		88	30	
3		90	36	
5	Tr. Digit.	66	34	
7	ʒi p.d.	86	30	
8		78	22	Feels weaker.
9		100	32	Cough very troublesome, still giddiness.
10		92	19	
11	ʒvi Digit. stopped	100	22	Headache. No appetite. Vomited, chest feels tight.
12		108	30	
13		96	29	
15		80	32	
17		82	22	
19		86	20	Very short of breath.

CASE 41, female, aged 28. *Tuberculosis of both lungs. Pyrexia.*

Housewife, suffering from advanced pulmonary tuberculosis of both lungs with considerable evidence of excavation. Temperature continuously raised between 100 and 103 degrees Fahr..

Date.	Drug.	Pulse Rate.	Remarks.
Oct.			
23		82	
24	Tr. digit. ʒi p.d.	84	
25	,,	110	
26		100	Vomited.
27	,,	100	Vomited.
28	Tr. digit. m. 20	110	Digitalis stopped.
29		120	
30			No further vomiting.

CASE 42, female, aged 30. Tuberculosis of both lungs. Pyrexia. Digitalis had no effect upon the heart.

Housewife. Suffering from advanced pulmonary tuberculosis of both lungs with evidence of excavation below the left clavicle. A pyrexial case. in which the temperature was uninfluenced by digitalis, the average evening temperature being 100 Fahr..

The pulse rate before digitalis was given (October the 23rd) was 88.

Date.	Drug.	Pulse Rate.	Remarks.
Oct.			
24	Digit. ʒi p.d.	90	
25		90	
26		80	
27		100	Slight headache.
28		100	Nausea.
29		90	Nausea.
30	Digit. stopped	96	Nausea.
31		96	

CASE 43, female, aged 36. Tuberculosis of both lungs. Pyrexia.

Book-keeper, suffering from advanced pulmonary tuberculosis of both lungs with continuously raised temperature, 99 to 101 degrees Fahr..

Date.	Drug.	Pulse Rate.	Remarks.
Oct.			
23	Before digit.	96	
24	Digit. m. 20 t.d.	90	
25		100	
26	,,	80	
27		100	Headache, felt sick.
28	Digit. m. 10 t.d.	90	
29		100	Patient felt sick and wretched this morning.
30	Digit. stopped	90	Patient still feels a little sick.

Conclusions.

The careful analysis of the symptoms of patients to whom digitalis has been administered brings out the fact that individuals react differently to the drug. So far as the heart is concerned, the difference is partly dependent on the nature of the lesion with which the heart is affected.

Cases of auricular fibrillation are more readily and more markedly affected than cases with the normal rhythm.

Digitalis, in a proportion of cases with the normal rhythm, affects the auriculo-ventricular bundle more particularly, producing partial heart-block.

It is suggested that the susceptibility of cases of auricular fibrillation may result from the tendency of the digitalis to affect the bundle, the change in the auricular condition rendering the bundle more susceptible to the influence of the digitalis. It is possible that in slowing the heart's rate, the digitalis acts by stimulating the vagus nerve. Digitalis tends to induce auricular fibrillation.

In two cases of tachycardia, arising from an abnormal source, digitalis caused the heart to revert to a normal rhythm, first inducing fibrillation of the auricle.

The diuretic effects of digitalis may be produced with no perceptible change in the heart.

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Fig. 52. A continuous electrocardiogram in three strips, showing partial heart-block in *CASE* 27. The waves *P* due to the auricle have a varying relationship to the waves *R* and *T* due to the ventricle. (See also Fig. 38 and 39).

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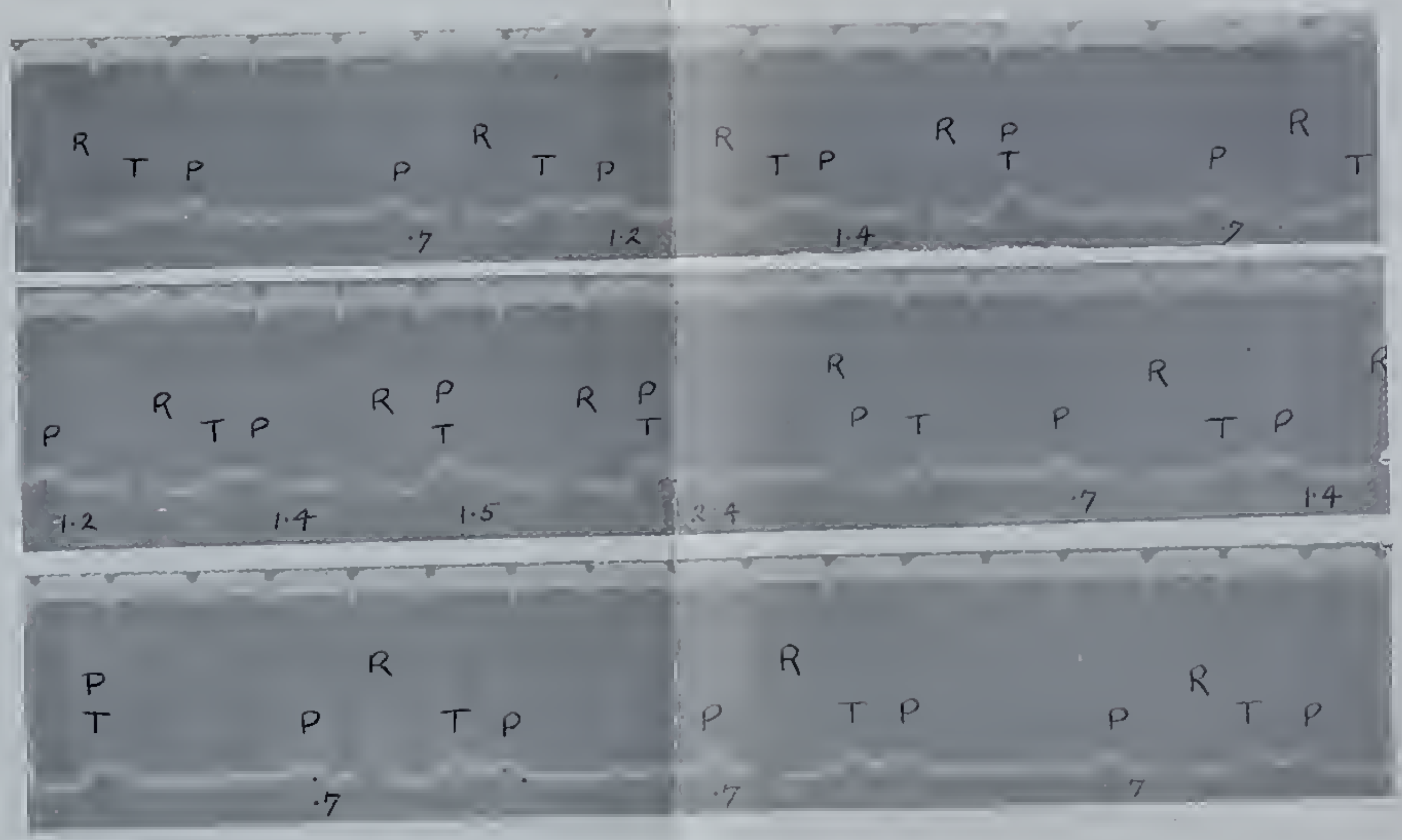
R T P P R T P R T P R P T P R T
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Fig. 52.

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Fig. 53. An electrocardiogram of *CASE 3* when the pulse was slowed from digitalis. To the finger the pulse seemed regular, but the electrocardiogram shows a slight irregularity, and the absence, which is characteristic of auricular fibrillation, of the summit *P*. The oscillations were obtainable in direct chest leads only.

Fig. 54. An electrocardiogram from *CASE 5* while there was a coupled rhythm. The ventricular beats of auricular origin are shown by the waves *R* and *T*; the premature ventricular contractions are diphasic, each follows a normal beat. It will be noticed that there is no auricular variation (*P*) present in this figure.

Fig. 55. An electrocardiogram from *CASE 5* during a period when the coupled beats were absent. The irregularity and absence of the *P* variation are characteristic of the electrocardiogram of auricular fibrillation.

Fig. 56. (*CASE 37*). Three electrocardiographic curves taken during a paroxysm of tachycardia. *I*, Lead from right arm and left leg. *II*, lead from right arm and left arm. *III*, lead from left arm and left leg. The broad dip preceding the sharp summit *R* in *I*, and the wavy line preceding *R* in *II*, is probably the representation of auricular systole.

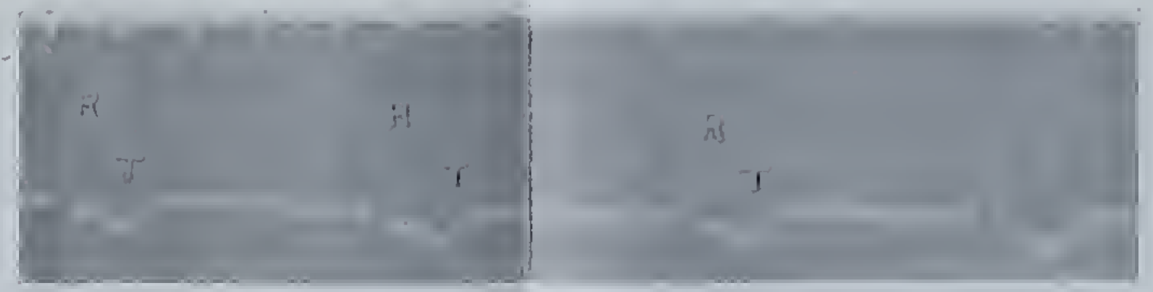

Fig. 53.

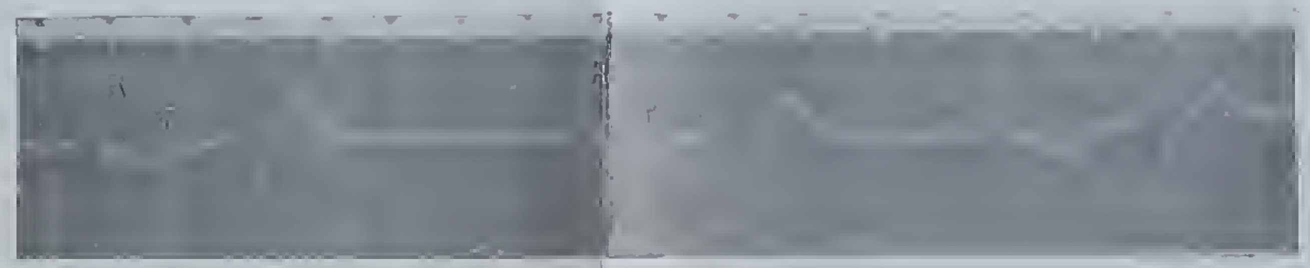

Fig. 54.

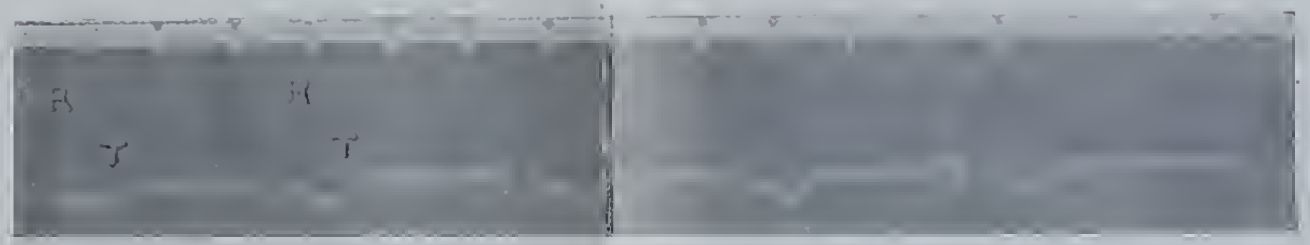

Fig. 55.

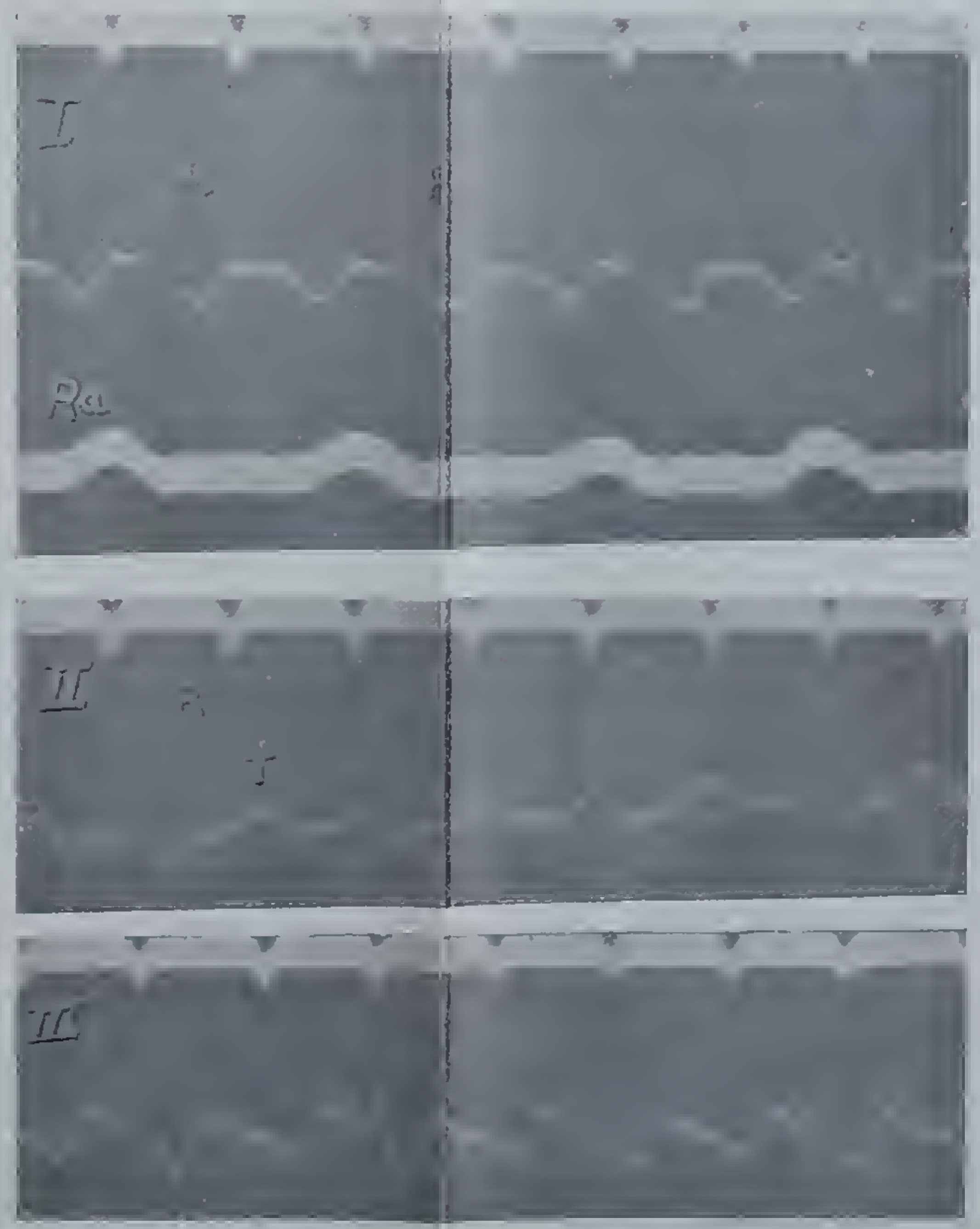

Fig. 56.

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